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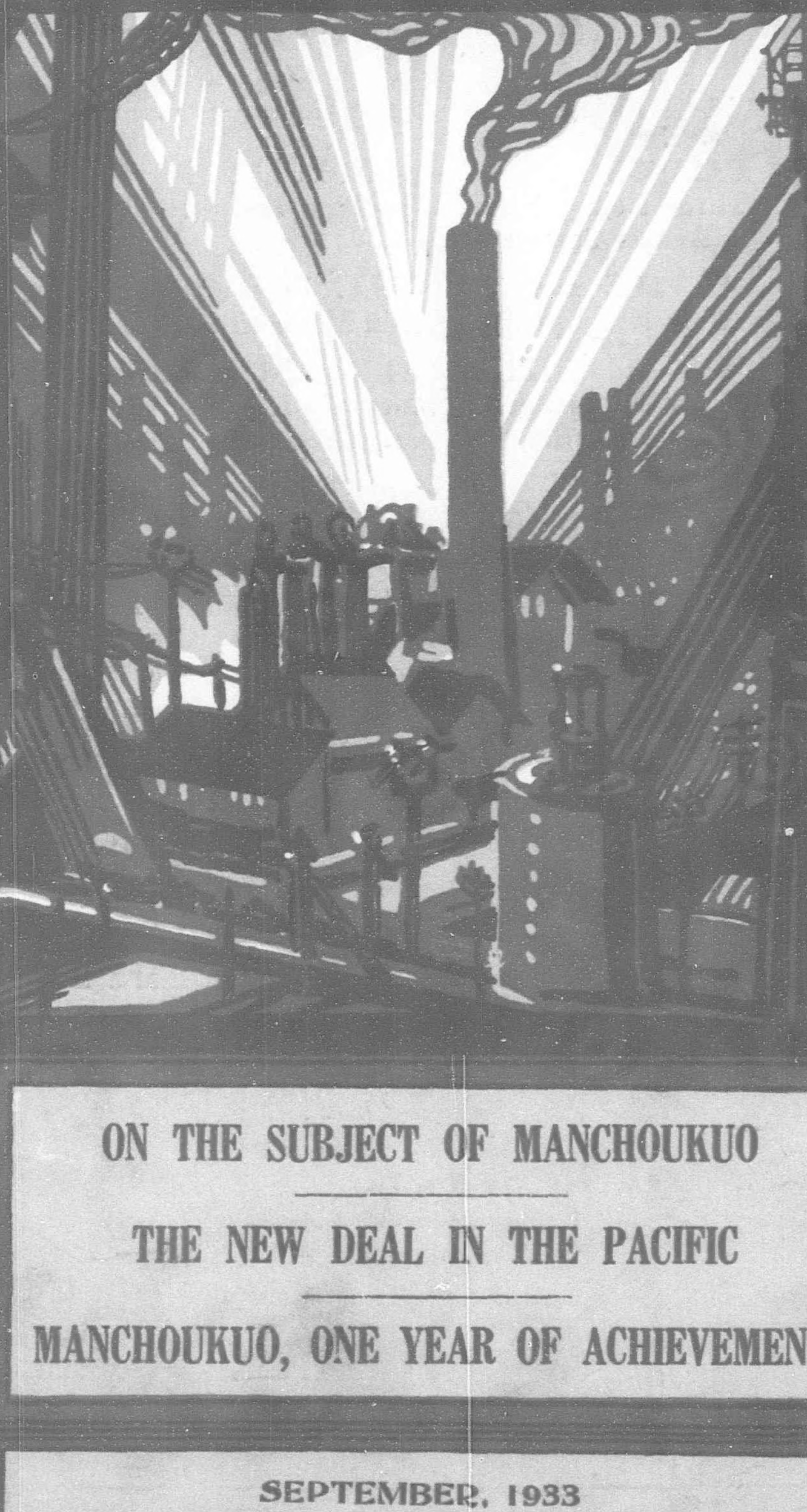


遠東時報

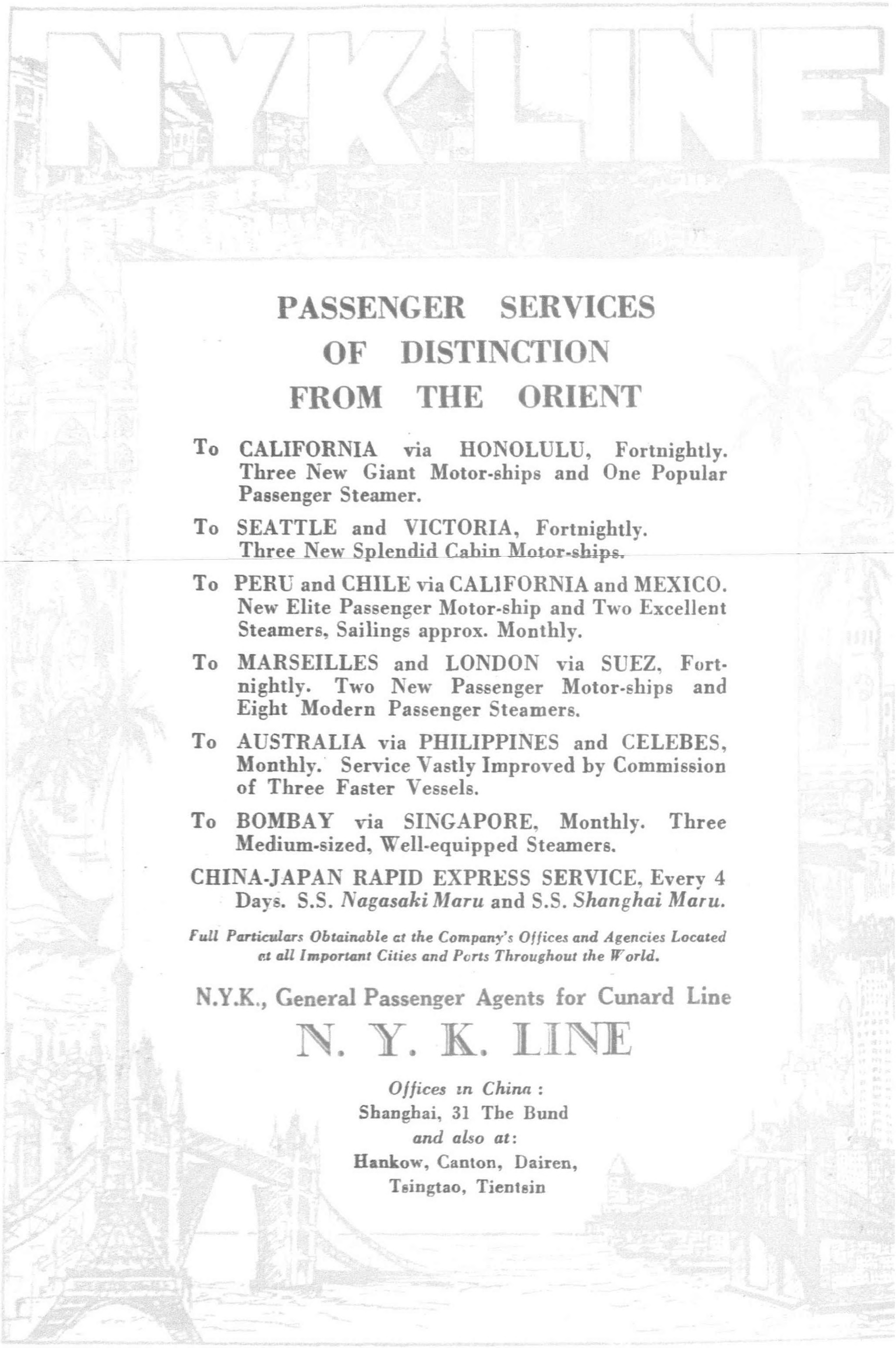
遠東雜誌第四號

ON THE SUBJECT OF MANCHOUKUO

THE NEW DEAL IN THE PACIFIC

MANCHOUKUO, ONE YEAR OF ACHIEVEMENT

Vol. XXIX | SEPTEMBER, 1933 | No. 9



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The Far Eastern Review

ENGINEERING FINANCE COMMERCE

VOL. XXIX SHANGHAI, SEPTEMBER, 1933 No. 9

On the Subject of Manchoukuo

By GEORGE BRONSON REA

NANKING contends that ninety-seven per cent of the population of Manchuria is Chinese. Who are these Chinese? Where did they come from? Are they Cantonese, Fukienese, Delta People, Hunanese or Szechuenese? It may be stated without fear of contradiction that there are no Southern Chinese immigrants domiciled in Manchuria. The adventurous Chinese from the southern maritime provinces find their outlet in overseas territories where they create the same problems that the Shantung and Chihli immigrants have raised in Manchuria.

In Manchuria, all immigration has proceeded from the two adjacent northern provinces of China Proper. If any Chinese have a right to exercise jurisdiction over the people of Manchuria, it is certainly not the Southern Group in power at Nanking, which cannot establish its rule in its own sphere.

Now, if the people of Manchoukuo are overwhelmingly Chinese, why should they alone of all the other recalcitrant provinces of China be singled out for punishment because they refuse to bow to the will of Nanking? If these people are patriotic Chinese, imbued with all the traditions of the race, is it not reasonable to assume that nothing, not even force, can permanently separate them from their brothers?

History invariably repeats itself. A Cantonese political faction in 1926, allied itself with Moscow in order to conquer and impose its rule over the rest of China. When the Chinese leaders understood that their Soviet allies sought to communize the nation and dominate the government, they promptly kicked them out. Should Japan attempt permanently to dictate and dominate the affairs of Manchoukuo, will not these Northern Chinese also assert their rights and join hands with their brothers inside the Wall to free themselves?

There is an old Chinese saying, **"By force we can never subdue peoples, but by kindness we will win their hearts and make them willing followers."** If, as Nanking contends, the people of Manchoukuo are Chinese, loyal to their racial traditions, why should it be necessary to utter threats and mobilize armies to subdue them?

Addressing the League, the Chinese Delegates declared that their armed forces do not exceed 1,500,000 while official estimates published in the Chinese press admit nearly 3,000,000, or more than the combined military strength of all the nations of the world. Added to this, are nearly two million communists, bandits and pirates, making a total of approximately 5,000,000 armed men living off the country; double the military strength of all other nations. The Chinese Delegates at Geneva professed their love of peace and desire for conciliation, while their armies have been slaughtering their own people by the hundreds of thousands.

Populations Exterminated

Since China appealed to the League in the dispute over Manchuria, nearly a million people officially have been reported killed or missing, as the result of the communist suppression campaign in the Yangtze provinces alone. While the attention of the world was concentrated on developments in Manchoukuo, a war, about which the world heard nothing, was being fought between two warlords for the control of the rich province of Szechuen. This conflict took a toll of over 50,000 soldiers killed and 70,000 wounded, in addition to 3,000 civilians slain. The destruction of property in this province has been enormous. Whole towns and villages have been bombed from the air, shelled by artillery and then looted and burned. The fighting in Shantung and along the Tibetan borders has accounted for another long list of casualities. Yet, with these truths standing unchallenged in the public press, Chinese leaders loudly profess their love for peace. Is it not time to face the facts? How long are these horrors to endure?

The people of Manchoukuo are tired of these senseless wars and the maintenance of useless armies which have bled them white. They entertain no animosity or hostility towards the people of China Proper suffering from the same tyranny from which they so fortunately have escaped. Their one hope is that in due course, either through their own exertions or through international co-operation, the people of all China will also be liberated from their bondage and stand united under a strong central representative government solicitous for their welfare and happiness. The people of Manchoukuo can never be subdued by force, but kindness and a respect for their rights and welfare may work wonders. Peace, prosperity and security for both peoples can be attained only by recognition of the accomplished fact.

As an independent State, Manchoukuo becomes the guarantor of peace in the Far East, a buffer state wedged in between three conflicting social orders that will absorb the shocks of their expanding influences. The League of Nations has created several new states in Europe in order to safeguard the security of that continent. If it sincerely desires peace in the Orient, it should apply the same principles to Manchoukuo and, when it has accomplished the task set for it by its Commission of Enquiry and established a strong Central Government in China, representative of the will of its people, it can then use its good influences to effect a rapprochement of Manchoukuo with a rejuvenated, reorganized and contented China, under some form of political equality perhaps similar to that which now binds together the independent units of the British Empire.

The Government of Manchoukuo desires peace and time to work out its own salvation. It harbors no intention of invading China or of interfering in any way with the affairs of China. It has no desire to obstruct the unification of China Proper by engaging in hostilities that will sap the strength of the central authorities.

The Position of Manchoukuo

The independence of Manchoukuo bears no relation to the dispute between China and Japan. Had the incident of September 18, 1931, not created the opportunity for the people of Manchuria to throw off the yoke of Chang Hsueh-liang it was only a question of time when some other combination of circumstances would have precipitated a more serious revolution. Basing their right to self-determination on a nationalism that has endured for centuries, the legitimate sons of the soil revolted against the oppressive rule of an alien régime and set up their own government. These people challenge the findings of the League that the land belongs to the Chinese immigrants.

The population of Manchoukuo cannot be properly classified until a scientific census is taken. For the present, the Chinese claim to an overwhelming majority cannot be substantiated by any reliable statistics. It can be proven that in the last 43 years not over seven million Chinese immigrants have entered and remained permanently in Manchuria, leaving 23,000,000 people to be accounted for. The Government of Manchoukuo contends that these people are the original owners of the land. The records reveal that up to 1911, the Eight Banner Corps retained full sovereignty and authority over Manchuria, compelling all immigrants to take out passports, and conform to rules and regulations which, for all practical purposes, were equivalent to the naturalization laws of other countries.

The question as to whether Manchuria belongs to the Hans or to the "Manchus" does not call for mobilization of armies or threats on the part of the Chinese that they will die to the last man before surrendering their claim to rule over this territory. The dispute is no different from any other conflicts of political opinion that are now being solved amicably in other parts of the world. It is decidedly a matter that can be settled by leaving it to the vote of the people. The legal machinery for ascertaining their wishes does not at present exist but there is ample evidence in the telegrams and documents that were sent to Geneva that a sincere desire for independence is now so strong and widespread that it would be unwise to ignore it.

The people of Manchoukuo cannot be handed over to a central government that does not exist. When China is united under a strong Central Government capable of asserting its power and jurisdiction over the whole country, the people of Manchoukuo might then consider some equitable proposal for joining a federation of sovereign self-governing Chinese states. Until that day arrives, the people of Manchoukuo are determined to seek a solution of their problems in their own way. They believe that not only the safety of China Proper, but their own existence depends upon their unfettered independence during the next few years. They are convinced that long before a strong Central Government can be established in China Proper, events will arise that will determine for the next century the course of Far Eastern history. They entertain no illusions about their future and intend to protect themselves while there is yet time to do so.

A Safeguard for China

In taking this irrevocable step they believe they will solidify their own status and independence and at the same time assure to China Proper that freedom from outside aggression so necessary for her own growth and development into a self-governing independent state. If Manchoukuo is not permitted to develop peacefully as an independent state; if, instead of concentrating on building up a strong central government, the Nanking authorities waste their strength in waging war against the people of Manchoukuo in order to hold them in subjection against their will, then the outlook for peace is far from bright. The armies of Nanking may eventually conquer and impose their rule over the people of Manchoukuo, but the reverse is also a possibility. Manchoukuo may emerge as the victor from such a struggle. Is it not better to settle this dispute peacefully by recognizing the right of the people of Manchoukuo to self-determination and await such time as a proper government is set up in China before pressing questions that belong to the future?

Despite its contradictions and inconsistencies, the Report of the League's Commission of Enquiry is clear and emphatic on the basic conditions prevailing in China Proper. The last suggestion of the Report (No. 10. "*International Co-operation in Chinese Reconstructions*") is the very essence of the findings of the Commission. Nothing can be done to give effect to the other conditions until a strong central government is functioning in China Proper which, as the Report recognizes, is possible only by building adequate means of transportation which will enable it to exercise its authority. A vast amount of time, money and effort has been wasted in diagnosing the ills of China, yet the verdict is always the same. The "Lytton Report" arrives at the same conclusions as the Strawn Report on Extraterritoriality and the Report on the Kemmerer Commission which based all its recommendations on the assumption that a strong, central government existed in China. If the League is to preserve its prestige and usefulness, it must give careful consideration to this last suggestion of the Report of its Commission and assume the responsibility of assisting China Proper to reconstruct itself to the point where a strong central government is set up capable of discharging its international obligations and its duties to its own people.

Even under the most favorable conditions this task will take many years. To-day, with an unprecedented world economic depression drying up the sources of credit, it may be difficult, if not impossible, to raise the loans to pay for building the means of communications that will enable a strong central government to exist. In the meanwhile, must Manchoukuo submit to the authority of a group of Southern war-lords and contribute her share of the revenues to maintain the armies upon which rests their right to rule? The Government and the people of Manchoukuo are unwilling to contribute in any way towards consolidating the power of a government which does not represent the will of all the people of China.

A Domestic Question

The supreme concern and duty of the League is the preservation of world peace. The dispute between China and Japan simmers down to whether or not Japan was justified in resorting to self-defense on the night of September 18, 1931. If Japan was justified, it follows that the independence and status of Manchoukuo is outside the jurisdiction of the League and becomes a purely domestic question between Manchoukuo and Nanking, in which war against the Central Government is not an act of rebellion but a test of supremacy between two independent factions. And as Nanking imposed its rule over the whole of China Proper with the aid of the Soviet, so will Manchoukuo defend its independence with the aid of Japan.

Although the League decided against Japan, it could not undo the independence of Manchoukuo. That, as pointed out, remains a purely domestic issue that concerns the people of Manchoukuo and a government which sits at Nanking and derives its right to rule from the recognition of the Powers and the weight of its armies. If the League is to use its powers to preserve world peace, the only fair position for it to take in this dispute is to recognize the right of the people of Manchoukuo to determine for themselves what government they desire to live under.

The time is long since past when people can be coerced against their will to remain in bondage to a system of government that denies to them their rights as human beings. Times have changed. Even the most advanced and so-called "imperialistic" nations have discarded force as an instrument to perpetuate their rule over peoples clamoring for independence or a larger share in the management of their own affairs. The fissiparous movements in these advanced states are being developed not by the slaughter of innocent people, but by the cement of good-will, honorable treatment, friendly understanding and recognition of realities.

If there existed in China a government worthy of the name, one that could faithfully discharge its international obligations and its fundamental duties towards its own people and devote part of its revenues for public improvements or education, there might be some reason in urging the people of Manchoukuo to acknowledge its jurisdiction, but when no such government admittedly exists; when a continuance of their allegiance would inevitably lead to further taxation for the upkeep of armies maintained to perpetuate their enslavement, it is hopeless to ask or expect the people of Manchoukuo to accept such a solution.

The Report of the League Commission of Enquiry cannot be read as an indictment against Japan alone. It says clearly that peace in the Orient, peace in the world, cannot be attained as long as conditions in China constitute a menace to friendly relations. Since the conditions set forth in the Report as a solution to the problem cannot be fulfilled without a strong Central Government in China, the final requisite for a satisfactory solution is temporary international co-operation in the internal reconstruction of that country. Here lies the task of the League; the guaranteeing and raising of loans aggregating nearly a billion gold dollars; the supervision of the expenditure of these huge sums; the efficient direction and operation of the means of communications and their protection against bandits and militarists. This, in brief, is what the Report says that the League must undertake in order that a strong Central Government can be set up in China. This is the fundamental issue before the League in the present dispute. Its duty and task are clear.

Will Work Out Its Destiny

While the League is occupied in its herculean task, it should feel gratified in knowing that it will not have to extend its operations north of the Great Wall. This considerably reduces its sphere of action and its responsibilities. Manchoukuo will work out its destiny and, when China is united under an enlightened and strong Central Government representative of the whole people and with the interests of the whole people at heart, it will be time enough to ask its people whether or not they desire to unite their fortunes with a rejuvenated China.

The Government of Manchoukuo declares that it will never submit to an outworn political doctrine so diametrically opposed to the principles of the League, the fundamentals of Humanity and the cause of World Peace. The people of Manchoukuo cannot be coerced to place themselves under the rule of the Nanking Government or admit the right of any Chinese war-lord to interfere in their affairs.

The people of Manchoukuo stand firmly on their inalienable right to rebel against oppression, misrule and injustice ; to exercise their right of self-determination and to secede from the rule of a bandit despotism ; to declare their independence and to set up their own government. It was their right and duty to throw off the yoke of their oppressors and provide new guards for their future security when the opportunity presented itself. The Government and People of Manchoukuo accept full responsibility for their actions and are prepared to maintain and defend their freedom by every means within their power. Invoking the fundamentals of civilization and the Rights of Man which to-day represent the most advanced policies of the more enlightened European states, the Government and the People of Manchoukuo appeal to the world to cast aside the legalities and petty international politics and to consider their case from the broader aspects of Justice, Humanity and World Peace. **Principles that apply in Europe, must apply with equal force in Asia.**

The New Deal in the Pacific

By HAMILTON BUTLER in "The North American Review"

At a time when tremendous forces, which can not fail vitally to affect the future of this nation, are taking shape in the Far East, we find ourselves at odds with two of the three powers and distrusted by the third, which, with the United States, are able, if they but co-operate, to make their fiat the law in the North Pacific basin.

The Soviet Union has given back snub for snub. Japan continues its reorganization of Manchuria undeterred by the State Department's attempt to fight fate with phrases. China can not conceal its impatience with a Government that talks so big and does so little. As a result of our recent meddling in Asiatic affairs, American prestige stands to-day, among the peoples directly affected by our uncertain diplomacy, at "a new all-time low."

The danger inherent in this state of affairs ought to be plainly visible to any American who is not congenitally condemend to take an exclusively immediate view of world events. Asia is in active revolt against the West. Whether or not we escape gracefully from the greatest catastrophe that diplomatic inaptitude has ever conjured up for a modern nation will depend on the amount of vision and courage that can be summoned, from now on, to the direction of American policy in the Orient.

The fundamental defect of our present policy in the Far East is that we approach Asia and Asiatic questions through Europe and European formulas. The State Department in Washington has become a partisan meddler in the internal affairs of Asia, after the fashion of the predatory chancelleries of the Old World. All the advantages that geographical position and political traditions gave us, as a logical mediator between the Old World of Europe and the new world that is fast emerging from the ancient civilizations of Asia, were scrapped when we abandoned our early policy of dealing directly with our Pacific neighbors and allied ourselves with the leading powers of Europe in a common policy in China.

Although Secretary Stimson's belligerent pacifism has made a bad matter very much worse, attempting to hold him solely responsible for our predicament in the Far East is dangerous, as well as historically indefensible : for, if we are to extricate ourselves, with honor, we have got to admit that we have been travelling in the wrong direction for more than 30 years and make a complete volte face.

The Original Blunder

The initial mistake of bracketing the United States with Europe in its approach to the Far East was committed by John Hay in 1898-99. Colonel Stimson's obstinate refusal to recognize realities rendered a dull animosity acute and threw the issue of war or peace with Japan into delicate balance with that disciplined the nation's self-control.

The United States got off to a good start in the Far East. A century and a half ago Americans were not imperialistically minded. They had at home more land than they knew, at the time, what to do with. Consequently they sought in China neither colonies nor naval bases, as the more forward European nations were doing. They had no opium to peddle. They fought no wars. They seized no territory. All they wanted was to trade—except their missionaries, who wished to proselyte.

The Chinese, another trading people, were quick to discover that they had nothing to fear politically from ships that came only to buy and sell. The foundation of a mutually profitable relationship was thus early laid. American business flourished, American prestige was high. American advice was sought. When he resigned in 1867 as American Minister to China, Anson Burlingame was invited by the Chinese Government to head the first general mission it had ever sent to the treaty powers.

A similarly helpful relationship developed with Japan, as well as with Chosen, when those countries were reopened to the world by American enterprise. Although much has happened in the past 30 years to mar the record, Japanese statesmen and publicists still allude, with grateful acknowledgment, to the early assistance received by their country from Americans and the American Government. The United States was the first treaty power to agree formally to tariff autonomy for Japan and thus—although this provision of the treaty of 1878 was contingent upon the other interested powers taking similar action—afforded the Japanese the incentive and encouragement to work for the complete abolition of extra-territoriality.

As long as this hands-across the Pacific policy was pursued Americans were regarded by their neighbors in the Far East as *sui generis*, a nation distinct from Europe, with New World aspirations instead of Old World ambitions, a co-operative member of a group of peoples surrounding a common ocean that belonged peculiarly to them.

All that went by the boards when John Hay returned from London to Washington in 1898, with the Philippines and the Open Door in his portfolio and in his brain the dream of keeping up with the Joneses of Europe in a scramble for "rights" and privileges in the Orient. Our Pacific neighbors could not be blamed for beginning to wonder if, after all, Americans and Europeans were so very different. They have since had abundant reason to change their first opinions of this country and its international ethics.

The retention of the Philippines, at Great Britain's request, was notice to the world that, while we objected to the extension of the European system to any part of the American continents, we intended to extend the American system to other parts of the globe, where we liked and when we liked. The Open Door policy in China, about which more nonsense has been talked and written than about any other factor in American foreign policy, with the single exception of the Monroe Doctrine, was American neither in conception nor in its development.

Secretary Sherman had previously rejected it, when the British Government first tried to put it over on the United States. The purpose of the Open Door policy was to protect British trade supremacy in China.

The effect of Secretary Hay's espousal of it was to give American recognition to the principle of European spheres of interest in China, where America had no such sphere, and to entangle this country with Europe in a politico-economic protectorate over China. The Open Door policy opened nothing that was not already open and has prevented nothing from being closed, where any other country has been determined to close it. China was not saved from dismemberment by it. American trade with China has not been increased by it.

It was a British Conception

The manner in which Secretary Hay went about obtaining the adherence of other nations to the principle of the Open Door was significant of the new orientation of American policy in the Far East. The Powers he first approached were Great Britain, a pardonable courtesy to the parent of his adopted child, Germany, France and Russia.

Only after that did he ask Japan, whose interest in the vast potential market of China far exceeded that of any European country, to join the party. And he overlooked China, which was both the subject and object of the proposed agreement, altogether!

The Chinese Minister in Washington had to go down to the State Department to find out what all the rumors of an international understanding respecting his country were about. The affront thus given to Asia did not pass unnoticed.

A single bit of irony relieved the dull picture. The Open Door agreement confirmed, and by implication justified, Japan's claim to a sphere of interest in the Chinese province of Fukien, where Secretary Hay wished to obtain a naval station for the United States—and found his ambition thwarted.

The policy of playing with Europe against Asia, thus inaugurated, was the beginning of a series of entanglements for the United States, which has continued down to the present day. At the Washington Conference we were still more tightly sewed up with the European countries having colonies in the Far East. The outlook for early and graceful disentanglement has not been brightened by Secretary Stimson's association of the United States with the League of Nations in an effort to influence Asiatic destinies by obstructing Japan's attempt to bring order out of chaos in a part of China in which geographical propinquity and economic necessity give the Japanese a peculiar and vital interest.

Among the mischievous consequences of this departure from early American policy has been an increasing disposition to take sides in Asia and play off one party against another, where we are not directly or immediately concerned. After the battle of Mukden and the destruction of the Russian Baltic fleet in the Sea of Japan, when it became clear that Japan had won its war with Russia, Theodore Roosevelt, who up to that time had hoped for and expected a draw in Manchuria, stepped in to prevent Japan from capitalizing its victory either in the field or at Portsmouth, where he used all his influence to prevent Japan from obtaining from Russia an indemnity to cover the cost of recovering Manchuria for China.

The Taft-Knox régime followed this lead, with its "dollar diplomacy" and a specific scheme for the internationalization of the railways in Manchuria, which would have left Japan with only a minority voice in the development of a territory strategically and economically "cognate" to it. The various consortiums in which American bankers have participated still more recently, with the approval of the Government in Washington, are merely links in the chain by which the United States has been bound to the principal European countries in a financial protectorate of China.

Are the Japanese altogether without justification in interpreting Colonel Stimson's encouragement of Chinese opposition to the pacification of Manchuria, as only another manifestation of a deliberate policy on the part of this country to block their expansion in Asia—or in resenting it as deeply as we should resent a similar attempt by Japan to interfere with the process by which American paramountcy in the Caribbean is maintained?

The effect of this intimate meddling in the Far East has been to alienate the good will of Japan, without bringing about any compensatory enhancement of Chinese affection for us. The Chinese have their own reasons for not loving the United States as passionately as they once pretended to. The fact is too widely ignored by Americans generally that the real issue between the East and the West is race—and the Chinese are just as race-conscious as we are. They might have become reconciled to their exclusion from this country if Americans had refrained from interfering in China; but, as it is, they resent our aggressiveness in the Far East quite as much as the Japanese do.

At the moment they are trying to use the United States as a cat's-paw against Japan. As soon as they get their nationalist machine in working order they will do more than pass toothless resolutions denouncing the "unequal treaties" upon which our "rights" within their borders rest.

The Chinese are a practical people. They judge others by acts rather than by professions. Our alliance with Europe, with respect to the Far East, was an invitation to them to boot us out of their country, when they boot Europe out. When they do that, we shall not receive as much as a "thank you" for all the cable tolls we have recently spent in their behalf.

A course of action so frankly inviting reprisals by our neighbors in Asia could be justified only by results that outweighed the risks so clearly involved in it. As a matter of fact it has failed completely to achieve the objects which this country has been popularly supposed to be seeking in the Far East.

American policy in the Orient has been described as "a policy or righteousness tempered by self-interest." At times it has had that appearance. At other times it has looked more like a policy of self-interest veiled in cant and hypocrisy. As a general thing, what it has aimed to do has been to maintain peace in and about the Pacific, to promote the welfare of the Chinese people and to obtain for Americans a fair share of the commercial favors China has to distribute.

Glance at the results of this noble experiment in the field of foreign affairs.

Effects of a Mistaken Policy

China is still rent by the civil wars that came in with the Republic upon which the Government in Washington was the first to bestow the blessing of formal recognition. The moral encouragement given by the Stimson-Hoover régime to Chinese war-lords to keep the fires of disorder burning in Manchuria has contributed to bringing China and Japan to open hostilities, when all interests concerned would have been far better served by encouraging China to accept the pacification of that bandit-infested area by Japan, as a friendly act of vicarious enforcement.

The probability is strong that if the United States and the League of Nations had minded their own business, Japan and China would long since have come to a satisfactory understanding, along lines familiar to and acceptable by Asiatic peoples. American jingoism has been excited by Washington's gestures to a point where a rupture with Japan lurks just around the corner.

Americans generally have a deep and deserved regard for the Chinese people. The existence of this feeling explains why it has been so easy for successive administration in Washington to obtain popular applause for "dollar diplomacy" or any other adventure in the Far East, which they could advertise as a sure cure for China's political or economic ailments. The condition of the patient before taking their nostrums has been drawn for consumption in this country, with the horrible details outlined in the deepest dyes. The condition of the patient after taking them is not so widely advertised. You must go to China itself for that.

At the time of the disastrous floods of 1931, a well-informed Shanghai publication, *The Far Eastern Review*, said of conditions in that distressed and bedeviled land:

> "There is no money in China for famine or flood relief. Every dollar that can be squeezed from the people in taxes or through confiscation of property and wealth goes to maintain the vampire armies sucking the last drop of the people's blood. The money that might be employed for the relief of humanity can not be diverted from the purchase of arms and ammunition. The maintenance of law and order, the first duty of organized Governments, is subordinated to the perpetuation of military rule.

"Over 5,000,000 armed men are living upon the impoverished people. Three million men are incorporated in the 288 divisions that make up the provincial armies. Nearly one million comprise the army of Chiang Kai-shek, the backbone of the National Government. The Manchurian armies number at least 500,000, Szechuen has over 300,000, Kuangsi and Kuangtung another 200,000. God alone knows just how many men are carrying a rifle in China. The bandits Communists and independent armies number more than two million.

Government in China does not represent the people. At the present time it is in the hands of a half dozen or more racketeering gangs, who are making hay for themselves while the sun shines from Washington upon them. They have made of the map of their country a political jigsaw puzzle which the most ingenious champion of "administrative integrity" finds it impossible to piece together.

The war-lords, who have been keeping China in turmoil for more than a decade now and are still going strong, are naturally agreeable to the policy of giving China all the time she needs to work out her destiny. They do not have to pay for the obstacles put in the way of the only country, Japan, which has had the courage to attempt to give Manchuria, what all China sadly needs, a respectable government, whereunder peace and order may prevail and the Chinese people may have an opportunity to translate their industry and thrift into happiness and contentment.

The tragedy of American failure in the Far East is that China's teeming millions have to pay for it—with their hard earnings and, too often, with their lives.

American commercial interests in China and the interests of the Chinese people, as distinguished from their native exploiters, are closely parallel. "A thoroughly modernized Asia will offer," says Julean H. Arnold, American Commercial Attaché "an opportunity in international trade probably surpassing that presented by any other section of the earth during all of human history."

The door to that opportunity has not yet been thrown open. Chinese conservatism has had its back to it from the beginning. Since the revolution of 1911-12 civil war and anti-foreignism have taken up the work of obstruction. Wu Ting-fang once remarked that if an inch were added to every Chinese shirt tail, all the cotton mills in the world would be kept occupied for a year supplying the increased demand for piece goods. Conditions of disorder have shortened China's shirt tail instead of lengthening it. Commerce does not thrive on chaos.

A well-ordered and progressive China would also present the most extensive field for the self-liquidating investment of foreign capital to be found anywhere in the world to-day. The lack of adequate transportation handicaps efforts toward unifying the country politically and takes a tremendous toll of life in times of flood and famine, when millions die in the midst of a plenty that can not be got to them.

Some Comparisons

China is about one-third larger than continental United States and has 17,000 miles of railway (if Manchuria's 5,000 miles are included). The United States has 250,000 miles. The construction of an adequate railway system, the development of motor highways and the release of the country's vast mineral wealth would absorb all the surplus capital Americans are likely to have to invest abroad for some time to come.

China could put $10,000,000,000 to work to-morrow and it can not borrow 10 dollars! The political uncertainties ushered in by the revolution combine with the fact that China is already in default on bonds aggregating more than $100,000,000 to discourage foreign investors from risking their money in Chinese Government securities.

The restoration of China to a condition that would invite foreign capital to flow freely into it would ease the burden of internal taxation that is being borne by the present generation of Chinese, would promote international trade to the profit of all concerned and would unlock the natural resources China has in abundance and which might be made the means of turning the Chinese from a race of beggars for outside aid into a wealthy, self-supporting and self-reliant people.

Japan realizes that; yet, when it takes definite measures to straighten things out in China, all it gets from this country is abuse. A fear seems to be prevalent among otherwise intelligent Americans that where Japan treads, American trade will wither like grass under the hoof-beats of Attila.

Consider these facts: After having traded with China for almost a century and a half, we did with that populous country in the peak year of 1929 a total business of $291,000,000. That works out to about 65 cents per capita of 450,000,000 Chinese. After having traded with Japan for about three quarters of a century, we did with that far less populous country in the same year a business worth $690,000,000. That was equivalent to more than 10 dollars per capita of 65,000,000 Japanese.

If China had been a province of Japan, if American trade with it had been subjected to the same tariffs and duties as applied to American trade with Japan itself, our trade with China's 450,000,000 in 1929 would have amounted to upward of $4,500,000,000, which is considerably more than the value of our entire foreign trade in 1931.

Take our exports alone. The Japanese bought American goods in 1929 to the value of four dollars for every mother's son of them: if the Chinese had done as much, we should have sold them products of American labor to the total value of $1,800,000,000. Actually, we sold them $124,000,000 worth.

The difference between our trade with Japan and that with China is the difference between dealing with an energetic, alert and orderly nation and with a nation whose development is retarded and whose buying power is dissipated by self-seeking and unscrupulous political exploiters.

Americans and Chinese would both profit by our recognizing, what is patently true, that Japan is doing more to open China's door to a more extensive intercourse with the rest of the world than all of our diplomacy from John Hay down has succeeded in doing. A rational view of the Chino-Japanese situation is this: If we want China to become united and strong, as we say we do, Japan's aggressive action will bring that about, if anything can.

If Japan can maintain a model government in Manchoukuo, at least a part of what was formerly China will enjoy prosperity, while the rest of that loosely-joined aggregation of provinces will have something to emulate. If Japan bankrupts itself in the attempt, we should worry. If 450,000,000 Chinese allow 55,000,000 Japanese to dominate them or any part of them, we must conclude that it is because they prefer foreign protection to exploitation by their own political freebooters. If the Chinese absorb the Japanese, as some of their spokesmen boast they have always done with races that have conquered them in the past, a new and improved ethnic type will be produced on the Asiatic mainland. The Chinese need nothing more urgently than an injection of bushido.

The truth of the matter is that Japan is merely attempting to abate in territory close to it a nuisance that we would not tolerate in any country to which considerations of our national defense could even remotely be attached.

The "Yankees of the East" are only borrowing a leaf from the book from which the Yankees of the West took the doctrine of Manifest Destiny. They are forced by Secretary Stimson's vehement protests to the conclusion that there is one law of growth for the Western Hemisphere and another law of growth for the Eastern Hemisphere. Why there should be is not clear to them.

Points One Way Out

The only way out of the dangerous and unprofitable situation into which we have been led in the Far East points directly back to the policy which, as a general rule, we followed down to the time when Secretary Hay went off on his imperialistic tangent. The essence of that policy, as General Grant stated it, was to encourage the development of a strong and independent Asia as a bulwark against European intrigues and aggressions. As recently as 1894 Secretary Gresham declared that the Sino-Japanese War "endangers no policy of the United States in Asia" and that "our attitude toward the belligerents is that of an impartial and friendly neutral desiring the welfare of both." Our troubles began when, five years later, John Hay made the United States a partisan meddler in Asiatic affairs.

As a result of the misconceived internationalism of the Stimson-Hoover Administration, we have become still more deeply involved

with Europe in the Orient. A year ago Viscount Ishii, alarmed by Secretary Stimson's reckless rhetoric, warned the United States that a situation of the utmost gravity would arise if it ever "attempts to dominate the Asiatic continent and to prevent Japan from pacific and natural expansion in this part of the world." Colonel Stimson attempted that very thing.

Still more recently Count Uchida has felt it necessary to declare that "any plan for erecting the edifice of peace in the Far East should be based upon the recognition that the constructive force of Japan is the mainstay of tranquillity in this part of the world."

Although an American Ambassador to Japan had said exactly the same thing a decade before, a reiteration of Japan's claim to paramountcy in its own part of the world, when made by Japan's spokesmen, was something that the Administration in Washington which had provoked it could not accept without complete loss of face.

A new Administration of a different political complexion and tradition, which entered Washington over the corpse of its predecessor's foreign, as well as domestic, policies, can return, if it will, to a rational approach to Far Eastern problems, without either losing face or placing unprecedented strain upon the doctrine of the sanctity of treaties.

The Nine-Power Treaty of 1922 can not be seriously said to be appropriate to conditions in China, after the lapse of more than a decade. The Pact of Paris does not deprive Japan of its right under the law of nations to act in self-defense or to judge for itself what constitutes a threat to its national existence and what means are necessary to remove the menace.

All that is necessary to brush away Secretary Stimson's sophistries and pave the way for a revival of our disinterested rôle in the Far East is to interpret those two documents as liberally, where China and Japan are concerned, as we should interpret them in this hemisphere, where our interests were vitally affected.

The reversal of the Stimson-Hoover policy of joining with Europe to meddle in Asia would be no more abrupt or radical a departure from the immediate past than was Cleveland's prompt withdrawal from the Senate of his predecessor's outrageous annexation treaty with Hawaii or Woodrow Wilson's discountenancing of his predecessor's support of American participation in an international consortium for the financial enslavement of China. Continuity of policy is a dangerous hobgoblin of small minds, where the policy involved has already led to unpleasantness and promises future disaster.

As a first step in recovering the confidence and good will of the Asiatic peoples with whom we share the North Pacific Ocean, we must recognize that they are entitled to the same freedom of action in Asia as we claim for ourselves in America and its adjacent waters. Collaterally, we must abandon the claim to privileges in their hemisphere, which we deny them in ours.

The fact must be admitted in practise, as well as in theory, that the Chinese, Japanese and other advanced Asiatic peoples, whose ancestors were highly civilized when ours were still in the Bronze Age, are in no sense our inferiors. They are merely different.

Admitting racial equality, which was rejected in theory at Versailles and in practise is still widely denied in Europe and America does not mean that we invite the unrestricted immigration of peoples who do not fit into our scheme of things : all it means is that we can not fairly and logically both discriminate against other nations in our country and insist upon preferred treatment for ourselves in theirs.

The Philippines should be abandoned at once. They have always been both an economic and a strategic liability to the United States. They were taken to please Great Britain and a handful of American imperialists. They should be given up to please a nation that has had 35 years in which to repent of what it sanctioned in haste and hysteria. And when we get out of the Philippines, we should get out all over. We can not afford to remain responsible for what another people may do on the other side of the world, after we have lost the power to control its acts.

The supreme absurdity of our Philippine adventure is the proposal, which Congress re-enacted over the Executive veto, that when and how we shall relinquish responsibility for the Islands shall be determined by a people whose capacity for self-government is still a matter of acrid debate in this country !

Any joint agreement with other powers regarding the Philippines, after we withdraw from them, should be restricted to Japan, China and the Soviet Union. After driving one European country out of the Islands there is no good reason for inviting any other European country to participate in their protection. Our outright retirement from the Philippines would be proof of the sincerity of our subscription to the doctine of Asia for the Asiatics, a gesture of confidence in our principal Pacific neighbors that would go far toward easing the tension created by the clamor of our big-navy people for a fleet strong enough to keep the Stars and Stripes floating over Corregidor.

Regarding Moscow

The Soviet Union should be formally recognized. The State Department has carried on long enough the puerile pretense that it is not officially aware of the U.S.S.R.'s existence. We recognized the Soviet Union in fact in 1928, when we signed with it the Pact of Paris ; we recognized it again in 1929, when Secretary Stimson communicated with it through Aristide Briand, with respect to the application of that famous pact to the squabble over the Chinese Eastern Railway. The Government in Moscow could not conceal its surprise at receiving word from another Government that did not know it existed !

The establishment of normal diplomatic relations with Moscow would in no wise prejudice our claims upon the Soviet Government for the sums owing to American citizens, or the American Government, which it so far has refused to admit constitute a charge against it. American labor would not suffer from it : for all our diplomatic snootiness has not prevented the Soviet Union from doing a larger business with the United States than with any other country in the world, with the single exception of Germany.

The idea that formal recognition of the Soviet Union would invite Communism to overthrow our cherished institutions is an insult to our national intelligence. When this nation contained only about 4,000,000 people and was badly divided into an English party and a French party, when Jacobin clubs were springing up in its cities and towns and its streets echoed the strains of the Carmagnole, George Washington was not afraid to recognize the French revolutionary Government and receive its agents, although in England and on the Continent the French terror inspired far more alarm than the Russian terror has.

Germany, a close neighbor of the Soviet Union, with a population about half the size of ours and with 6,000,000 Communist voters in it, survives diplomatic and commercial relations with Moscow. We, with about 60,000 Communist voters in our midst, are only encouraging Communist propaganda by turning pale at the sight of a crossed hammer and sickle.

Any effective and successful Pacific bloc cannot be hoped for without the cordial co-operation of the Government controlling Siberia ; and is it not rather too much to expect such co-operation, as long as we treat the Soviet Government as a bootlegger, with whom we are ready to deal in the alley, but are ashamed to be seen speaking to in public ? Why be so squeamish about Moscow, when we have taken to our diplomatic bosom the far less respectable Government in Nanking ?

Above all, the United States should be severed from the League of Nations and its provocative action in the Far East. The League of Nations is in both conception and purpose un-American. American internationalists had dreamed of a league of nations in which all nations would be equal before the law, a true parliament of man. The organization set up by the Treaty of Versailles was merely the old Concert of Europe under a new name, with the same old drivers holding the reins, a device to throw the mantle of pacifism over the enforcement of a punitive treaty.

The efforts that have been made to get the United States bodily into the League have been merely a continuation of the efforts made at Versailles to involve this country in a pact guaranteeing France's security : we were thus to become co-guarantor of a treaty the Senate rejected.

Great Britain and France have engagements in the Far East, at variance with our interests, which shape their overt and covert policies. The smaller powers in the League are meddling in what does not concern them in the hope of creating precedents in the Orient that later they may be able to invoke in Europe against their powerful and predatory neighbors.

The United States cannot too soon get its head out of the yoke Secretary Stimson thrust about it when he went into partnership with the League of Nations in connection with the Chino-Japanese misunderstanding. Our fate in the Pacific is too important to be dictated by a bunch of little countries who do less business with China and Japan in a year than we do in a week. We do not consult Japan or China when we have a bone to pick with Spain or Czechoslovakia : why should we take the latter into account when we have something to say to our neighbors across the Pacific ?

The Rising Tide

The unescapable alternative to thus recovering the good will of our neighbors in the Far East is worth examining. All Asia is in ferment. A billion people are in different stages of revolt against white dominance in their part of the world. They have a single objective : Asia for the Asiatics. A very brief excursion into history is sufficient to explain what it is all about.

When Colombus sailed from Spain in 1492 to discover a new world in America, virtually the entire white race was cooped up in the comparatively small continent of Europe. Within the short space of four and a half centuries the white race has brought the entire world under its more or less complete control. The spawn of Europe have occupied the Americas and parcelled out Africa among themselves. They have populated Australia and the islands of the sea. They have made India a footstool. They rule Siberia. They enjoyed extraterritoriality in Japan for half a century—and still do in China, whose littoral from Kwangchouwan to Tientsin is dotted with their colonies, concessions and leased territories.

The savage aborigines of America and Africa could offer no effective resistance to this white invasion. They were annihilated or submerged. Asia was a different nut to crack ; for there the white man found more than half the population of the earth, already highly civilized and frankly disposed to look down upon him as an upstart, a condescension which he has since given them little reason to alter.

The one thing the Asiatics lacked and the white man possessed, which enabled him to work his will upon them, was gunpowder. All they needed to put him back in his place was to equal him in the application of modern science to the art of fighting. They have that now. The yellow race has always had a preponderance of manpower and it is rapidly overtaking the white race in the science of warfare. A day of reckoning is at hand when the "foreign devils" that have so long disturbed the Far East will find themselves confronted with their own fire, which they have taught the Orient how to use.

America is so situated as to be able, if it will, to cushion the blow, when Asia rolls back the white invader and reasserts its right to be master in its own house. Although their stock stands to-day in the Far East at a low point, as the result of interference in other people's affairs, Americans have a vast fund of good will, accumulated in the past, which they can fall back upon if they but have the courage and vision to approach Asia again, with the substantial evidences of sincerity already outlined.

The extension of the regional principle to the Pacific cannot fail to appeal to the other nations directly concerned, if it be undertaken on a basis of racial equality, as a rational means of settling Pacific questions, without the interposition of European countries that have been nibbling at the Orient for more than four centuries and still hold much of it in thrall. We owe nothing to Europe, while Europe owes much that it will never repay. What we owe to ourselves is to escape from entanglements that will make it possible for Europe to put us in the middle when the shooting begins.

Asia is not looking for a world war. All it is seeking to do is to solve its own problems in its own way, which in the end it will do, whether it be this year or 10 years or 50 years hence. Any extension of the present Sino-Japanese conflict beyond its natural theater will have to be invited by this country or Europe, or both. Japan is merely putting into affect, while we have been talking about it, General Grant's idea of a strong and independent Asia. Whether we are to make of that Asia friend or foe will depend upon the promptness with which the Government in Washington reverses itself and again sets its face to the west, where our future still lies.

Manchoukuo, One Year of Achievement

By ISOSHI ASAHI, Japanese Vice-Consul in London, in "The Asiatic Review"

NOTWITHSTANDING the world-wide depression referred to by Mr. Ramsay MacDonald in his opening speech to the World Monetary and Economic Conference, Manchoukuo's international trade increased by more than three-quarters during 1932, offering a ray of sunshine to what might be described as a picture of unrelieved gloom.

The combined figures of the foreign trade of Dairen, Antung, and Newchwang, the three greatest sea ports of Manchuria which usually represent 70 to 80 per cent of Manchuria's foreign trade, for one year ending February 28, 1933, covering exactly the first twelve month of Manchoukuo's existence, show the aggregate of 569 million Manchoukuo yuan* (to be abbreviated M. yuan throughout the present article) as against 248 million M. yuan for the preceding one year, an increase of 77 per cent. Exports increased by 45 per cent to 320 million M. yuan, while imports increased by 150 per cent to 248 million M. yuan.

A casual glance at the latest available trade returns shows that this phenomenal increase in both imports and exports is shared by all countries with the single exception of Germany, and counters the argument raised in some quarters that Japan is putting obstacles in the way of Manchoukuo's declared policy of the Open Door and Equal Opportunity. Articles have appeared in some newspapers to the effect that Japanese merchandise was given preference to the exclusion of British and other foreign goods in spite of the professed policy of the Open Door. An answer to this assertion is to be found in these returns:

THE FOREIGN TRADE OF DAIREN, ANTUNG, AND NEWCHWANG

(Unit : 1,000 Manchoukou yuan)

Countries.	*Exports.*		*Imports.*	
	Mar., 1932, to Feb., 1933	*Mar., 1931, to Feb., 1932*	*Mar., 1932, to Feb., 1933*	*Mar., 1931, to Feb., 1932*
Japan	121,777	110,780	167,119	57,191
China	55,281	50,801	46,009	26,016
Britain	30,161	8,384	3,382	1,343
France	2,239	554	258	88
Germany	4,971	10,916	2,639	3,338
Holland	41,534	19,550	765	823
U.S.S.R.	253	35	1,355	692
U.S.A.	4,728	5,352	3,862	2,423
Others	52,606	16,009	22,837	6,019
	320,550	222,381	248,226	97,932

*The approximate value of the Manchoukuo yuan is 1s. 3d. It was established as the Manchoukuo unit of currency by the Monetary Law of June 11, 1932, and is equivalent to 23.91 grammes of fine silver. The Chinese character used to denote the Manchoukuo yuan is the same as the one used for the Japanese yen. This fact was a constant source of difficulty to the League Commission of Enquiry (see the Lytton Report). The monetary unit of the Nanking Government is also yuan, which is sometimes called Mexican dollars in English. But Nanking uses a different Chinese symbol from that used by Manchoukuo. The Chinese yuan has the legal standard of 23.9775 grammes of fine silver. For these reasons the term Manchoukuo yuan is used in this article in contradistinction to the Chinese yuan and the Japanese yen.

It may be pointed out that the imports from Great Britain nearly trebled, as did those from Japan. It is true that the year 1931 cannot be regarded as normal in any comparison of the trade of Manchuria on account of the Manchurian incident of September 18, 1931. But credit for regaining that normalcy in trade, which is conspicuous by its absence elsewhere in the world, must first go to the Japanese and Manchoukuo authorities, who devoted a large part of their energy, time, and treasure for the restoration of peace and order in Manchuria during the year under review.

Through the energy of the forces of Japan and Manchoukuo the difficult task of restoring peace and order within the borders of Manchoukuo was very largely carried out within one year of her foundation. Thus the spectacular advance of the combined forces of Japan and Manchoukuo through Jehol Province in the early part of March this year closed the campaign of pacification which was started last autumn after the harvest of the Kaoliang, the staple food of Manchuria.

At the time when the Lytton Report on Manchuria was published on October 1, 1932, there were over 220,000 men under arms hostile to the new State, including bandits, political and otherwise, insurgents, Kuomintang agents, and the so-called "volunteer forces for the salvation of the Fatherland." 70,000 men were distributed in the mountainous regions of Kirin Province. Heilungkiang Province harbored 38,000, while the newly-created province of Hsingan had 13,000. Nearly half of the 220,000 were threatening the borders of Mukden Province with headquarters in Jehol Province. From official sources it can be shown that, after six months of campaign, all the hostile elements were completely suppressed or expelled with the exception of about 20,000, the majority of whom are bandits. They are now scattered all over the country, reduced to a position which forestalls any concentrated attack upon Manchoukuo. Over 35,000 have definitely pledged allegiance to the new State and have been placed on farms or reorganized into peaceful units to be employed in road-making or similar constructive enterprises.

Side by side with the suppression campaign, the authorities of Manchoukuo proceeded with the reorganization of the police force. Under the old military régime of Chang Hsueh-liang each province had its own independent police. Bribery and nepotism were often the means by which men were appointed to higher posts in the police. As a rule the police were inefficiently trained and uninstructed in their duties. Nor was this to be wondered at having regard to the inability of the officers to support their families on their small pay. The expenditure of the police was farmed out to the highest bidder, who in his turn imposed all kinds of taxes and contributions upon the people, using the police as their collectors. There was little or no distinction between the police and the army. Soldiers often exercised police authority and were able to carry out arrests and executions.*

In order to eradicate these evils Manchoukuo embarked upon a number of reforms. The police systems of the various provinces were unified, the sole control of which is now vested in the Department of Civil Affairs in Hsinking. A staff training college for the police force was established in Hsinking, while a training school of lower grade was started at each of the provincial capitals. Selected officers have been sent to Japan to receive special training. The pay of the officers was substantially raised, with the result that the lowest paid constable in Manchoukuo to-day receives 18 Manchoukuo yuan a month. The average pay of the constable under the old military régime was 6 or 7 yuan a month. The lowest monthly salary of the frontier policeman was raised to 60 M. yuan from about 7 yuan under the old administration.

Important progress was also made in the administration of justice. In the pre-Manchoukuo days incompetent and unqualified persons frequently found their way to the Bench by influence, just as in the case of the police and other branches of the public service. Military satraps appointed and dismissed judges at will. The pay of judges was insignificant. Power and favoritism were liable to influence the verdict and supersede the law. The military intervened in the administration of justice and exerted pressure on the judges.

With an enthusiasm which was manifested everywhere in her activities, Manchoukuo earnestly set about to remove these abuses. The power of appointment and dismissal was taken from the provincial governments and is now transferred to the newly-created Department of Justice in the capital. Capable and qualified judges were appointed to the newly-established Supreme Court, the building for which is in actual course of construction in Hsinking. The annual expenditure for justice was increased to 4,476,000 M. yuan from about 1,400,000 in 1930. The old system under which the maintenance of judicial organs was farmed out by contract gave way to the modern Budget system. A commission of able men was appointed to draft the Constitution of Manchoukuo and other substantive laws of state. Schemes are being formulated for the introduction of the examination system of judicial officials in order to raise the standard of their qualification. A number of promising officials were sent abroad for the study of the judicial systems of other countries with this end in view.

Perhaps the most outstanding accomplishment in the initial year of her administration may be found in the fields of public finance, banking, and currency. To gain a rough idea of the conditions prevailing in the pre-Manchoukuo days reference may usefully be made to the Special Studies by the experts of the League Commission of Enquiry as contained in the "Supplementary Documents to the Report of the Commission of Enquiry." To quote from this publication, "amongst the many evils of Chinese and Manchurian financial methods, absence of publicity was one of the most characteristic, and therefore information of a budgetary and financial nature is extremely scarce. As a matter of fact, even the most sincere effort to produce reliable financial statements would have met with failure owing to the complete absence of regular methods or records concerning revenue and expenditure. . . . . There was no proper Budget system nor did there exist a proper system of assessment and collection. Owing to the absence of a properly unified system it was a general habit to levy taxes of a temporary nature for local and 'special' purposes. These latter taxes were not based on proper regulations. Even the rate might vary according to the circumstances or the whim and needs of the person levying them. Finally it often happened that military authorities covered their financial needs by imposing tributes in an absolutely arbitrary manner."†

The new State successfully adopted and introduced the Budget system and placed before the public the accounts of the nation's income and expenditure. A uniform system of tax collection was introduced. In the place of the old "contractors," modern collecting offices were established at a number of places throughout Manchuria under state officials directly responsible to the Government. The military expenditure, which used to absorb 80 to 90 per cent of the entire revenue, was drastically reduced to one-third. Ten kinds of irregular or burdensome taxes were totally abolished, and five taxes were reduced by half in order to lighten the burden of the people. The total of the taxes thus abolished or reduced amounted to about 10 million M. yuan. It is needless to say that no new tax was introduced in their stead. Thus the tax burden of the people in general was lightened by one-third. The restoration of peace and order in the country, coupled with the improvements introduced by the new State, resulted in actual increase of national revenue month after month. The revenue for the half-year ending December 31, 1932, was estimated at 37,473,000 M. yuan. The sum actually paid into the national treasury during this period was 37,733,000 M. yuan. Her Finance Minister, Mr. Hsi Chia, is firmly convinced that an annual increase of 20 million M. yuan can be easily made in the revenue in the next five years.

On the question of Manchurian currencies the League of Nations expert writes that, "There are few provinces of China in which the currency chaos matches that to be found in the north-eastern provinces. Not only does one find that each of the three provinces has its own peculiar, but not always mutually exclusive, currencies, but also that various cities in even the same province have theirs, and that any one of the currencies may fluctuate violently and enormously with respect to almost any and all of the others . . . the Chinese authorities have always lacked either the will to standardize and unify the currencies or the power and ability to do so. They have almost from the very outset consistently abused the note-issue by turning out in endless variety ever-increasing quantities of constantly depreciating fiats."‡ The fengpiao, or the irredeemable notes of Mukden Province, is a representative of these inconvertible notes. "From 1920 on the

*A General Outline of Manchoukuo, Hsinking, 1932, p. 26.

†Extracts from Study No. 4, pp. 124 and 126.

‡Study No. 5, *ibid.*, p. 138.

Mukden authorities were preparing for war and financed themselves almost entirely by the issuance of fengpiao. The Chinese authorities, during the course of the fengpiao's depreciation, were continuously laying the blame on exchange shop dealers, speculators, profiteering merchants, and the Japanese, seldom making reference to the enormous injections they themselves were making into the media. Chang Tso-ling made numerous ingereous attempts to discover costless and inexpensive methods of bolstering the tottering currency. . . . During the latter part of August, 1926, he had five prominent merchants and nine money brokers shot for speculating in currency and had many others arrested and in some instances even confiscated the property of those whom he executed. Despite these drastic measures the fengpiao dropped with renewed vigor and merchants dared to refuse acceptance of it altogether."* During the years 1930-1931 its market value fluctuated between one sixtieth and one-sixty-fifth of face value. Official attempts to retain it as the sole standard for quoting prices and keeping accounts had to be abandoned in 1927.

Manchoukuo did not repudiate this worthless paper money. She took it over, redeemed it with the notes of the new-founded Central Bank of Manchoukuo which have always been accepted at their face value. By October last year she had thus redeemed nearly one-third of the old notes in circulation. The actual amount of the old notes thus collected and destroyed between July and October 18, 1932, reaches the total of 43 million M. yuan calculated in the new currency. Stated in the terms of the old currencies this shows the following remarkable total:

Convertible Tayang notes, Mukden	11,750,000 yuan
Inconvertible notes, Mukden (fengpiao)	24,000,000 ,,
Same without official seal (fengpiao)	1,558,000,000 ,,
Inconvertible notes with or without official seal, Kirin ..	2,374,979,902 tiehs
Tayang notes, Kirin	13,681,500 yuan
Harbin Tayang notes	496,500 ,,

The Central Bank was established on June 15, 1932, absorbing the four old note-issuing institutions. The minimum reserve against the notes issued by it is prescribed by law at 30 per cent, but the actual reserve never fell below 50 per cent. Consequently its notes are being freely circulated at face value throughout Manchuria and are widely used for quoting prices of commodities, a fact reflecting the confidence of the Manchurians in Manchoukuo and her future. What the Bank has been able to achieve during the brief space of less than one year of its establishment is certainly a credit to the leaders of Manchoukuo.

Consideration of space compels me to spare you further details of the tangible beneficial results which one year of Manchoukuo's administration has brought about—results which may be tabulated. There are, however, other things which cannot be stated in the definite terms of hard cash, but which nevertheless play a far more important rôle in the welfare and happiness of the people of Manchoukuo and in the peace of the Far East. The principle of "Wang-tao" occupies the forefront of these things. It is the very principle upon which Manchoukuo was founded. It gave, and will continue to give, to her enthusiastic state builders that guidance, the outcome of which was the wonderful achievements briefly described in these pages. It is the cardinal principle of ideal government in the Far East for five thousand years. Literally translated, it means the Way of the King, and is frequently referred to as the Kingly Way in many publications. It is the antithesis of "Pa-tao," or the Way of Might. "Pa-tao" values the law above morals, coercion above agreement, might above right. One of the practical applications of "Wang-tao" is Manchoukuo's opposition to Communism. Another is the withdrawal of those anti-foreign text-books which Nationalist China imposed upon the school children of Manchuria on the pretext of teaching Dr. Sun Yat-sen's "Three People's Principles." This one measure alone will go a long way in the furtherance of international peace.

The next in importance is Manchoukuo's diplomatic policy. The fundamentals of her foreign policy are set forth in her Declaration of Independence of March 1, 1932, and are enlarged upon in the letter addressed to various nations by the Minister for Foreign Affairs, Mr. Hsieh Chieh-shih. The principles therein enumerated contain equality of races, the Open Door, and Equal Opportunity—features lacking practical application in many parts of the world to-day. Those who care for peace in the world should take notice of Manchoukuo's foreign policy, as it is bound to affect the international situation of the Far East for many years to come.

*Study No. 5, *ibid.*, pp. 144-6.

New Japanese Railways

The Government Railways will open for traffic some dozen new lines having a combined length of some 250 miles, during the 1934-35 fiscal year. Of the total, four or five will be built via the regular construction channels, while the others will be designated as urgent projects.

This is the program decided on by Railway Minister Mitsuchi in accordance with his principles of building and operating the Government Railways from the standpoint of industrial development economic utility, and national defense.

The Railway Office estimates that approximately Y.32,000,000 will be needed for operating the new lines during the next fiscal year, over and above the construction cost, which is incorporated in the current fiscal year's appropriation.

Upon drawing up the 1934-35 fiscal year budgetary estimates, Railway Minister Mitsuchi has reason to believe that the Government Railways will net a revenue in the next fiscal year far in excess of the sum of Y.450,000,000, calculated to be made by the Government roads during the current fiscal year.

Supposing the revenue increase amounts to Y.70,000,000, the Railway Minister would rather expend the major portion of that difference for the improvement of tracks. Under the circumstances, the Railway Office expects to raise the sum of Y.48,000,000 through the flotation of loans, subject to the approval of the Diet.

Listed below are lines for which construction work was begun during the current fiscal year:

Futamata-Toyohashi line, to be completed during the 1936-37 fiscal year; Yawatababa-Uwajima line, to be completed during the 1937-38 fiscal year; Kamishihoro-Mitsumata line, to be completed during the 1938-39 fiscal year; Nakahyotsu-Hyocha line to be completed during the 1938-39 fiscal year; Yamada-Kamaishi line, to be completed during the 1939-40 fiscal year; Ofunato-Mori line, to be completed during the 1935-36 fiscal year.

New Power Plant

The expenditure of Y.2,000,000 is scheduled by the Japanese Railway Office for the construction of a generating station at Mishima to supply power for the coming electrification of the Tokaido line near the Tanna Tunnel.

Part of the sum will be used for high tension transmission towers and for the installation of a new block signal system in the section. Ten special electric locomotives for taking trains through the tunnel, are also to be constructed.

It has been decided that the Tokyo Railway Bureau is to take charge of the entire project and the bureau authorities are said to be feeling very optimistic.

The authorities are confident that regular scheduled traffic through the Tanna Tunnel will be realized in April, 1935. When the switching in of the main line tracks is finished, six stations on the present Tokaido line in the vicinity of Hakone will be dropped from the main road. The present section will become a branch line of the Tokaido.

The Tanna project was first estimated to require Y.14,000,000, but already the sum of Y.17,000,000 has been expended and an additional sum of from Y.3,000,000 to Y.4,000,000 is considered necessary.

When the electrification of the Tanna line is completed, a great deal of power will be required. The Mishima generating station's output would be insufficient, it is considered, and the Railway Office authorities are to negotiate with the Tokyo Electric for the purchase of additional power.

The Government line electric plants at Akabane and Kawasaki, Tokyo, are already taxed to capacity, so that power from these sources cannot be used for supplying the demand at Tanna, it is further pointed out by the railway engineers.

At the present time, the railway authorities are purchasing over 50,000 kilowatt hours of electric power per diem at the rate of 2.3 sen per kilowatt hour. When the Tanna electrification is completed 10,000 additional kilowatt hours a day will be necessary, it is estimated.

Trade Schools for China

The Demand for Well Trained Foremen and Artisans

By Professor C. A. MIDDLETON SMITH, M.Sc., M.I.Mech.E.

THE purpose of a trade school is to train manual workers to become better craftsmen and to enable them to carry out the duties of foremen or overseers. The instruction given in the school is of a very practical nature. Until recently no effort seems to have been made in China to provide trade schools.

Enormous sums of money have, in recent years, been spent in China upon University buildings, and there are many institutions for providing higher technical education of a theoretical type. A number of engineering graduates from these institutions have been very disappointed to find that, after years of study, they have been unable to secure good salaries. Employers have complained that they have lacked practical experience, and efforts have recently been made to remedy the defect. But graduates of Universities expect to rank as commissioned officers in the industrial army. And what are wanted, more than anything else in China are well trained workmen and foremen. The trade school, the junior technical school, and evening technical classes, are badly needed in the cities of China to-day.

Hongkong has made a start. There is now a junior technical school, and in time that will we hope lead to the formation of a proper trade school and up-to-date evening technical classes. Details of the work done and contemplated are given below.

Shanghai Responds

During a recent visit to Shanghai an opportunity was given to me to address a mixed audience of Chinese and Europeans on the subject of applied science development in China. Reference was then made to the great need in Shanghai (and in other places in China) of establishing trade schools for training artisans.

The response that was made to that suggestion was remarkable. After the meeting, a number of those present asked for further details, and expressed themselves greatly interested in the subject. Subsequently, a number of letters reached me, requesting that representations on this subject should be made to the Shanghai Municipal Council, to the Nanking Government and to various other bodies, and asking for further particulars about trade schools. In all these cases a reply was made to the effect, that as soon as possible, more information would be given.

It is therefore proposed to develop the subject so that all who are interested in commerce and engineering work in the Far East may know more about trade schools.

Skilled Labor Essential

All of us who have watched the increase in the demand for machinery in this part of the world are convinced that nothing can stop the inrush of applied science in China. Chaotic political conditions, the factional fights of intriguers for office, and the military exploits of various War Lords, may retard it. The lack of skilled labor must in any country make industrial development more difficult and more expensive. Valuable machinery will be ruined unless it is looked after by those who know what to do in the daily routine and in emergency.

But finally, the industrial revolution will spread all over the Far East. Machinery will be used, communications improved and the standard of living raised. We may safely visualize the China of the future as a country in which rivers will be under control and floods no longer dreaded by millions of the people ; where power will be behind the worker to enable him to multiply his energy and to live a life more free of toil and anxiety. Irrigation schemes will be made more efficient, there will be enormous improvements in transport and all sorts of communication, the mineral wealth of the country will be available and the ceaseless energy of the rivers will be transformed into electric power. Not only will the standard of living be raised but the average length of life of the people will be increased by pure water supply, modern sanitation and buildings of steel and concrete.

Commerce and Humanitarians

Thus we see that all sections of the community ought to be interested in the engineering development of China. The fortunes that have been made by many Chinese and some Europeans in Shanghai, Hongkong, Tientsin and other places, have been created by the application of modern scientific methods to industry. There is money to be made by a large number of enterprising people in China if they can be persuaded and permitted to work under reasonable conditions, schemes that will utilize the bountiful resources of Nature for the use and convenience of man, in this part of the world.

The wheels of trade will rotate much more rapidly when there is an increased demand for machinery in China, and when more of the raw materials of the country are sent to Europe and America to pay for the machinery. The ships will carry heavy cargoes : banks, insurance companies and agents will benefit. Members of every grade of society, from the highest to the lowest will have a chance to improve their material possessions.

Humanitarians, missionaries and social workers, should do their utmost to encourage Chinese to develop the natural resources of their country, for it is only when the intense struggle for existence becomes less acute (so that people have time to think about other things than food and shelter) that any progress can be made in missionary work.

It is therefore suggested that missionaries, as well as commercial men, should advocate trade schools in China. The example of the Salesian Fathers in Hongkong, who have established the St. Louis Industrial School, is well worthy of imitation.

It is noticeable that in recent years philanthropic bodies all over the world have come to the conclusion that material assistance should be given to people in areas affected by famine and flood in China. Many enlightened Europeans support the efforts made to build hospitals and to teach hygiene. And there is now encouragement for all kinds of applied science work in China. But the extension of the idea of a trade school is needed in the big cities of China and should be supported by all missionary bodies.

The average Chinese workman is intelligent, industrious and good tempered. He is splendid material. But he must be thoroughly trained if he is to know all that he should know about modern machinery.

It is noticeable that in Shanghai, Hongkong, and other places there have been, for many years, facilities for teaching young Chinese of both sexes and in all grades of life, writing, reading and other subjects which have a commercial value. These schools enable those who have to earn a living to become clerks, or teachers ; or to take up other types of what in England are called " white collar jobs." That is to say, jobs where the worker does not dirty his hands.

There has, however, been until quite recently no training for workmen. Those who have become mechanics, or artisans, have simply imitated other workmen ; but the latter have had no thorough instruction—they have only been able to pick up a certain amount of craftsmanship ; and often the result has led to inefficient methods. What is needed is systematic instruction in craftsmanship.

It is suggested that separate and distinct types of schools should be available for those Chinese who either are, or wish to become, skilled workmen.

There should be evening classes for those who are already at work all day. And there should be day classes for boys between the ages of 12 and 16 years and also day trade schools for boys (or girls) from 15 years up.

The Trade Schools

Soon after my arrival in Hongkong, in 1912, an opportunity occurred to ventilate this subject of technical education for workmen. There was, at that time, under the Government Education Department, a so-called Technical Institute. There was no building for the Institute—evening classes were held in one of the schools. But the classes were not of the type to attract Chinese workmen. All sorts of subjects, including typing and shorthand were in the syllabus ; but there was available no machinery or other suitable equipment for helping artisans to learn the essentials of their trade.

A few years ago a body in Hongkong called the Chinese Engineers' Institute sent a deputation to seek advice from me on this matter. The Institute was really a sort of trade guild, with several thousands of members. They did make an effort to help their members in the way of instruction. They had teachers in elementary English, because they realized that a knowledge of that language is essential for understanding technical terms. The deputation explained that in Canton the mechanics had erected a building where regular evening instruction in technical subjects and English was given to their members. The men had tried to help themselves to become better workmen.

It was not, however, until 1930 that a move in the right direction was made in South China. In that year the Hongkong Government appointed a Committee to enquire into the subject. The terms of reference were " to report on the possibility of increasing facilities for practical technical education and the feasibility of establishing a Trade School."

That Committee consisted of Sir William Hornell (Chairman) ; The Hon Dr. Tso Soon Wan, Mr. De Martin, Mr. Chau Tsun Nin, Mr. R. M. Dyer, Mr. A. S. Mackechan, Mr. T. R. Shaw and myself.

The report finally presented by what was generally called the Trade School committee, strongly advocated a Trade School for Hongkong. As far as is known to the writer the report was never published. But one very important result of it was that the Hongkong Government decided to accept the proposal to establish what is now called " The Junior Technical School." Further development will follow. There seems to be no reason why the Shanghai Municipal Council (or the Lester Trust of Shanghai) and the Nanking Government should not follow the example of Hongkong.

A Pre-Apprenticeship Training

The general purpose of this Junior Technical School is to deflect boys of about 13 years of age from a training for " white collar jobs" to one that will enable them to become highly skilled workmen. Boys are to attend this junior technical school until they are 17 years of age when they will enter an industrial establishment as apprentices and qualify to become skilled craftsmen at the age of about 22 years.

Enquiries made in the dockyards of Hongkong and of local employers of skilled labor, revealed the fact that a knowledge of the English language is greatly prized, for it is, in fact, a financial asset. In nearly all places promotion has been given quite as much on a man's ability to speak and understand English as on account of his knowledge of his trade.

Having decided to have a Junior Technical School, the Hongkong Government appointed a well qualified Principal who had had considerable experience in technical education in England. They were fortunate in obtaining the services of Mr. George White, B.SC., A.M.I.MECH.E, who has organized the school. He is responsible to the Director of Education. This latter official is appointed by the Hongkong Government to supervise all education (except in the University) in the Colony.

Some excellently situated school buildings, on the island, which had formerly been used for teaching purposes, where placed at the disposal of the Principal of the new junior technical school. There is ample room for extension of premises.

One of the problems to be tested was whether in spite of all that had been urged in favor of a trade school, there really was a demand for it amongst the Chinese workers. Would there be many or few applicants to take advantage of the facilities offered ? A fee of three (Hongkong) dollars monthly was to be charged for instruction in the new school. Would workmen pay that amount for their son's schooling ?

We can imagine the mixed feelings of those who had to launch the scheme about the probable response. In actual fact the response must have exceeded their expectations. It was announced that 40 boys would be admitted. And there were 350 candidates for the 40 places. So that careful selection was possible and the school started well.

Selecting Candidates

Those who had been in touch with the Chinese workmen in engineering trades knew that they wanted their sons to have a better training than they had had. Many years ago (1926) the writer addressed a letter to the Director of Education in Hongkong on this subject. In that letter the following statement was made :—

> " You will remember that I have spoken to you on the general subject of technical education in this Colony ; I should like to put before you some of my views and I shall be glad of any comments which you may care to make upon the subject.
>
> " At the present time, for all practical purposes, the only engineering education that is available in Hongkong is that given in the University and which is designed for Engineering graduates. There are a few classes connected with the Hongkong Technical Institute which are suitable for those engaged in industrial work, but speaking generally, the Technical Institute is at present much more serviceable to the clerical class than to the artisan class.
>
> " There is a great demand in this Colony and in China for Chinese workmen who are trained to be non-commissioned officers or foremen. I propose, therefore, for the time being, to direct your attention to this problem.
>
> " I am informed that nearly all of the boys who attend Queen's College have only the ambition to become clerks. Many of them are said to earn a maximum of $30 or $40 a month, and they must keep up an appearance on that salary. As a good fitter can always earn $40, a chauffeur $60 and a foreman up to $100, I suggest that some effort should be made to deflect the boys of Queen's College from clerical to technical life.
>
> " There are, of course, many other aspects of the problem of local technical education, and there are details in the above scheme which will no doubt require to be elaborated. It is, however, useless for me to give details unless I am sure of the sympathy both of the University Authorities and the Government. I am therefore putting forward these general views, more in a nature of any enquiry as to what is likely to be the attitude of the Government on this very big problem. I need scarcely say that I shall be only too pleased to do everything possible in my power to assist in any scheme of improving the training of artisans. I am quite sure that a more educated and better trained class of workmen would be invaluable.
>
> " There is one other urgent need in Hongkong and that is the provision of night classes for apprentices and workmen who live in (*a*) Western District Hongkong (*b*) Hunghom, and perhaps (*c*) Wanchai. There are night classes organized by the Taikoo Dockyard for their workmen.
>
> " These night classes should give very elementary instruction in the English language (including technical names) elementary mathematics and elementary machine drawing. It is clear that some of our local engineering graduates could help with regard to instruction.
>
> " An incentive should be some form of certificate, possibly two certificates, stage I and stage II.
>
> " I have, for many years, taken a great interest in the local Chinese Mechanics' Guild, sometimes known as the Chinese Engineers Institute, and I would remind you of the loyalty of the members during the troubles of last year. I have found that men of Chinese artisan class work well and are worthy of any assistance in educational facilities which can be given them so that they may improve the general living conditions for themselves and for their families.
>
> " I have not mentioned the provision of evening technical classes corresponding to those provided in the technical institutes of large towns in England, as I think that the more urgent need is that of the Chinese artisans and apprentices.
>
> " I should be glad of any comments you may care to make on these suggestions."

No notice was taken of that letter—it was not even acknowledged, although subsequent personal enquiries elicited the fact that it

had been received. But the then Director of Education was not interested in technical education.

Father to Son

The tradition that a son is destined to follow in his father's footsteps still holds amongst the workers in the engineering trades in Hongkong and probably exists all over China.

The reader may be reminded that it was a deputation of Chinese workmen who had waited upon the writer and urged him to make representations to the proper authorities about the need for technical education. The chief manager of the Hongkong and Whampoa Dock Co., some years ago, had suggested that the local University should recruit engineering graduates from the sons of mechanics, as they would be more likely to take full advantage of a technical training than the sons of wealthy parents.

The University Authorities carefully considered this suggestion and made a great concession in favor of engineering apprentices. Instead of taking five subjects for the matriculation examination, they need only take two (English and Mathematics) and they can obtain the Degree in the usual period of four years, if they can pass the examination which takes place at the end of the first year. This examination is on the subjects of instruction in the first year engineering course. Although this regulation has been in force for some years, no candidate has yet taken advantage of it; probably because the knowledge of English and Mathematics amongst apprentices is not sufficient, and also because of the expense of the University fees. Incidentally it may be mentioned that generous benefactors might endow University Engineering scholarships for the sons of artisans.

Family Traditions

It is obvious that the sons of workmen are less likely than the sons of office-workers or shopkeepers to have ambitions for "white collar jobs." It was therefore a wise move, in Hongkong, to offer a number of vacancies in the Junior Technical School to the sons of workmen in the various local engineering establishments.

Of the 40 boys selected from the 350 candidates the following numbers had guardians (usually parents) in the establishments named, (*a*) Hongkong and Whampoa Dock Co. 7 (*b*) Taikoo Dock Co. 7 (*c*) H.M. Dockyard 7 (*d*) Public Works Department 8 (*e*) other occupations 11.

Brains and Physique

It could not have been supposed that Chinese boys, sons of workmen, at the age of 13, would have a very good knowledge of English. And, although a boy may have a facility for passing school examinations, it does not follow that he will prove a good foreman when he grows up. Indeed, the reverse is more likely to be the case. And a boy quick at book-work is more likely to seek out office work in manhood. So the idea of any written examination test for admission to the trade school was abandoned.

It is, moreover, generally believed that boys who are good at written examinations usually have a poor physique and suffer from defective eyesight. Hence the wisdom of Cecil Rhodes in making it a condition for the valuable Rhodes scholarships that written examinations should measure only 40 per cent of tests given, the remaining 60 per cent being awarded for personality, school sports, leadership, etc.

So the selection of 40 out of the 350 candidates was made by interviews and general questionings. A medical examination helped to make sure of the candidate's fitness for manual work.

Advertising the Scheme

The authorities concerned with the Junior Technical School in Hongkong wisely determined to advertise the scheme. It has always been urged by the writer that the Council of the University of Hongkong should advertise the unique facilities for higher technical education which have been provided by the princely endowments of Chinese and Europeans. The fact, for example, that the fees paid by students come to less than one-third of the cost of the University education should be more widely known. It is hoped that funds will be available for advertising the fact that Chinese students from any part of China may obtain an engineering training, equal to that given in the University of London, if they come to Hongkong.

Advertisements concerning the Junior Technical School (which is restricted to Hongkong boys) were inserted in the local English and Chinese Press, and a pamphlet in English and Chinese entitled "Education for Industry" was circulated throughout the Colony. The response, as stated above, was much better than most of us interested in the scheme thought possible. For 350 candidates presented themselves for entrance to the school.

It was decided to divide the 40 boys finally selected into two classes when the school opened on February 15, 1933.

The division depended on the boy's knowledge of English. A class of 18 boys was established in which each of them has received from one to three years instruction in English. There is also a class of 22 boys with no previous knowledge of English.

Subjects of Instruction

During the first year the subjects of instruction arranged were English, Arithmetic, Technical Drawing, Carpentry, Technical English and Hygiene. That list is an excellent basis for the day technical schools which the writer hopes to see established in the near future in Shanghai, Nanking, Hankow, Tientsin, Canton and other centers in China.

There are two facts which the sponsors of the new schools should keep in mind. Firstly, that success, or partial failure, will depend very much on the personality of the Principal. A European, of experience in technical education, and with a fluent command of English, is essential; and a good salary is needed to attract the right man.

Secondly, remember that 350 candidates presented themselves in Hongkong when there was accommodation only for 40 boys. Shanghai could be sure of at least 100 candidates each year and might provide for that number as a minimum.

A Four Years' Course

The experience of the first few months of work in the school has proved, beyond cavil, two important facts. One is that there is a desire on the part of parents to have their boys trained in the school. The other is that the boys, also, respond well.

In the senior years (third and fourth years) it is probable that the boys will receive instruction in science subjects and the benefit of experimental laboratories. And no doubt there will be available a sort of small museum with engine parts, to help in the work of technical English. The writer has found, with University engineering students (who usually have no knowledge of technical English when they commence their training) that the elementary experiments with levers, screw jacks, etc., in the Applied Mechanics Laboratory, help them in this matter. These experiments also teach them something of the laws of elementary mechanics—valuable knowledge for anyone in the engineering or building trades.

No doubt a small shop, equipped with lathes and other machine tools, will be provided in time; also a technical library.

It is, of course, early to make proposals about leaving certificates after a four years' course; but no doubt the boys will be graded and given suitable certificates which will be very valuable to them in after life.

They should be qualified, after a period of apprenticeship subsequent to leaving the Junior Technical School, to work up to become foremen in engineering works, junior draughtsmen, clerks of works in building or allied trades, foremen builders, etc. No doubt, in time, some of them will become contractors. It is noticeable that many of the successful Chinese building contractors in Hongkong have had no technical training, but have managed to succeed chiefly because of their knowledge of English and their possession of a business instinct and general common-sense.

It is to be sincerely hoped that exceptionally bright boys from the school will be assisted to take a full course of engineering training at the University.

Apprenticeship Problems

When the boys pass out from the junior technical school, and enter the practical life of trade apprenticeship, school instruction should not cease.

It may be possible to arrange with employers that the apprentices shall spend certain afternoons in school. And proper provision should be made for evening classes.

Then, again, the idea of the "trade school" might be developed to supply full-time instruction for boys over 17 years of age. In some parts of the world such instruction is given in all sorts of trades; probably out of this Junior Technical School a more complete trade school will grow. A good commencement has been made and proof obtained of the demand in China for technical education of all types.

The Present Staff

It is evident that the Hongkong Government wanted to be assured of the demand for the Junior Technical School before engaging an expensive staff. At present there is the Principal, two University Trained Teachers (B.A.) from the Hongkong University, and a part-time carpentry instructor.

It will surely be necessary to provide more full-time instructors. Chinese graduates with engineering degrees—and a fluent knowledge of both English and Cantonese—will be needed. Also a full-time instructor in carpentry.

It is of interest to notice that there is no instructor in building construction. That is probably due to the fact that all of the boys seem to wish to take engineering rather than building apprenticeships.

The Building Trades

On many occasions the writer has discussed with local architects and civil engineers this problem of training men for the building trades. They say that most of the recruits, in the past, have been illiterate, or at the best have had very little teaching in vernacular schools in Hongkong. With such recruits, and no instruction in craftsmanship, finished workmanship is not likely. And that is what the building trade suffers from in Hongkong. Local architects do not favor a "school" for training bricklayers, masons, carpenters, etc. They say that better *workmen* are required, and that if boys are taught "sciences" they will be educated to a plane above doing manual labor, which will defeat the object of obtaining better workmen. A boy with a good "school" education will not be content to lay bricks or work as a mason, whereas the same boy going through an apprenticeship as a mechanical engineer sees before him much better prospects if he has had a good "school"—especially technical school—education.

And so, they say, you cannot put the building and engineering trades on a par. The average boy entering the building trade is poor, and must earn a living at a very early age. He has little or no learning to begin with, and if he is to be retained in the trade must not be "educated above it."

In Hongkong the Salesian Fathers have a school where the teaching is craftsmanship. That system finds much favor with local architects, and they think that it, rather than a Junior Technical School, is most likely to produce skilled workmen in the building trade.

In that connection it must be noted that in England the output per worker in the building trade has steadily diminished as the type of education has been raised all over the country. Wages have also increased very much. Hence the cost of building is ever so much greater than it was forty years ago in England.

However, in a general survey of technical education in England (1926), prepared for the then President of the Board of Education, Earl Percy, a curriculum is set out for a building trade technical school. It contains the following subjects, viz. English; Mathematics and Geometry; Science; Technical Drawing; Building Construction; Workshop (Carpentry and Painting). Towards the end of the curriculum, building construction is introduced and workshop hours extended.

Teach A Craft

In discussing this subject with prominent engineers in Shanghai, general agreement was expressed with the suggestion that what is needed is instruction in craftsmanship. These engineers all felt that the Lester Trustees might have provided such instruction years ago. "Why didn't they hire a godown and have instruction in plumbing, electric wiring, etc., all of which work is being done badly in Shanghai."

I pointed out to them that the Trustees had not been indifferent to the claims of engineers and the provisions in the Lester will for technical training but had investigated, very thoroughly, all types of technical education for artisans.

But there is a general impression that in this matter the experience and co-operation of engineers in Shanghai is essential for success.

Well, the Lester Trustees have at last made an announcement about their efforts on behalf of technical education in Shanghai. Unlike the Hongkong Government, they seem to be entirely ignoring the mechanical and electrical engineering trades. They seem to be concentrating on the building trades. It will be of interest to learn details of their plans for a trade school for carpenters, plumbers, etc.

It is generally believed that the Trustees have available large sums of money for technical education in Shanghai. The development of their plans, and the response of the working classes, will be awaited with the deepest interest.

As the Lester Trustees appear to have abandoned the idea of technical instruction for the engineering trades there is every reason to urge the Shanghai Municipal Council to give attention to the creation of technical schools for training artisans.

Trades Schools in Malaya

There are trade schools in Kuala Lumpur and Bagan Serai (Perak) both in Malaya. The first course established in the former school was to provide a training for motor mechanics, but students joining the course are required to attain proficiency in mechanical workshop practice before being allowed to specialize in motor vehicle maintenance and repair work.

It was intended to introduce, eventually, "such courses as plumbing, building and stationary engineering."

The course in motor mechanics extends over a period of three years in the school and an additional year in one or other of local garages of repute.

The course was planned to include (a) in the first year, iron bench work and black smithing (b) in the second year, machine shop and advanced bench work, including component parts (c) in the third year, garage work, embodying the miscellaneous work involved in the repairing, turning, testing, driving and maintenance of motor vehicles.

The aim of a machine drawing course in the first two years was to teach students the mathematics of common questions, arising in the shop, and such knowledge was would be of practical value to a mechanic, viz., technical terms, free-hand drawing of simple automobile parts, drawing to scale, the principles of projections and sections, the design of simple machine parts and the reading of working drawings.

Another feature of the scheme was the system of accurate accounting to give students a knowledge of modern shop organization and business practice. Students were to check labor reported on weekly time sheets, materials and tools issued, etc.

Candidates for admission to the school must be strong and well developed and over 14 years but under 17 years of age.

The school started with 20 pupils, each of the Federated States being asked to send five students. During 1928 there were 35 cars of 17 different makes passed through the school.

The motor mechanic instructor was recruited on a salary equivalent to the sterling pay of £560 a year, rising by annual increments of £28 to £840 a year. In the first instance his appointment was for three years, but it was subsequently confirmed; and he was placed on the pensionable establishment of the Federated Malay States.

The Principal of the Technical Schools in Ceylon receives a salary of £950. He is a B.Sc and M. INST. E.E.

The maximum salary of a school-master in the Hongkong Government Education Department is nominally £950, but certain headmasters reach a maximum of £1,300.

The Trade School in Perak

This is situated at Bagan Serai. The subjects taught are English, arithmetic, drawing, carpentry and hygiene—very much the same as in the Junior Technical School, Hongkong. In 1927 and 1928 the average enrolment was 47. For personal enrolment, etc., the expenditure for 1928 was only $5,334 (Straits Currency) and other charges $1,673. The cost of each student in 1928 was $149.08 which seems to be a very low figure.

The Director of Education reported in 1928 that there was a great demand for additions to this school and that owing to lack of accommodation many applications had been refused.

In 1925 a Commission was appointed by H.E. Governor of Singapore to consider the feasibility of Industrial and Technical Education in Singapore and the type and classes of instruction required. They found that, in Malaya at the time there were practicing four consulting engineers, 732 civil engineers and surveyors, 107 architects and 996 mechanical engineers.

With regard to professional engineers, the Committee mentioned the difficulty of employing locally trained men to supervise labor comprising several different races. They said "The case of Hongkong is different. China offers a vast field for Chinese engineers." The view was held that "Chinese domiciled in Malaya would prefer to learn engineering at Hongkong and that it would be better for them to do so." And so it was wisely decided to avoid a large expenditure on a University technical college in Malaya, but to co-operate with Hongkong.

Many of the best engineering students in Hongkong have come from Malaya. Large contributions to the funds of the Hongkong University have also come from Chinese domiciled there.

The Building Industry

To revert to the class of workmen employed in the building trades, it would seem that this labor is recruited, in Hongkong at any rate, from much more rudimentary material. A recurring supply of boys from villages become bricklayers. They get themselves attached to building and become what are locally called "makee learn pidgins." For two years they watch others lay bricks. Then they join the guild and get taken on as workmen. They have no proper instruction.

There appear to be no reliable foremen and the only effective supervision over building is that which can be effected by the architects.

It would seem that the best way of improving matters is to extend the type of school founded by the Salesian Fathers in Hongkong to train bricklayers and carpenters. Incidentally it should be mentioned that this Institute has trained illiterate boys to become, not only useful in the building trade, but others to work as tailors, shoemakers, book-binders and painters.

In London there are two excellent institutions known as the Brixton School of Building and the Beaufoy Institute South Lambeth, closely connected with the building trades. They are really "Junior Technical Schools." They take in boys from the age of 13 years. During the first year the boys do a fair amount of manual work, and this, includes carpentry, bricklaying, masonry, plumbing, etc. At the end of their first year they specialize in some definite trade. After the first year they specialize, and are, as it were, linked up with the future employer by having their names placed on his books. Thus when they leave the junior technical school to enter practical work jobs are waiting for them and employers ready to take them on. And it is very noticeable that employers are eager to obtain Beaufoy and Brixton boys.

When the boys leave school they become trade apprentices but many of them continue their studies in evening technical classes.

There is no reason why there should not be instruction in carpentry, and even in simple iron work, in all schools for Chinese boys. In the schools in England for the sons of rich, and those for the poorer classes, there is now such instruction and its value has been definitely proved.

The Leaders of Industry

During the last thirty or forty years a very large number of well-educated young Chinese have graduated in Universities in Europe, America and in the Far East. Engineering has been quite a popular subject. The training which these young men have received has varied a great deal, for the many centers of learning have had different standards. No one doubts that some of the degrees held by Chinese engineering graduates are evidence of good intellectual ability and useful theoretical knowledge; on the other hand some of the degrees cannot be regarded in the same category—they are not real evidence of a good training.

In general the difficulty in the past has been for the Chinese engineering graduate to obtain practical experience in actual engineering work. In some cases enterprising young Chinese men have entered large works in Europe and America after graduation, in order to obtain practical experience. But it has not been generally enough recognized that a University degree is only the first part of the qualification for an engineer. It must be followed by practical experience, and that is, indeed, insisted upon by the leading technical societies in Great Britain.

A great difficulty in the past has been that there have been few opportunities for young Chinese graduates to obtain experience under well qualified engineers. They need instruction in practical work after their University training and it has been difficult for them to obtain such instruction.

Critics have often asked the writer whether Chinese engineering students dislike doing practical work. After twenty-one years of experience it is possible to say that, if proper instruction is given in workshops, etc., they become very interested in such experience. There are, in all engineering schools, in any part of the world, students who prefer study to working with their hands. But the average in the Hongkong University is about the same in London.

The Chinese Workmen

It is of very little use to train only Captains in the industrial army. What is needed, even more than University graduates in China, is a large number of properly trained mechanics, electricians, plumbers and others who have been taught to handle, to maintain, and to repair modern machinery.

At present there is practically no proper method in China of training such men.

It is therefore hoped that the general information given above about trade and technical schools will be of some service in convincing readers of this journal of the urgent need for their establishment in China.

Japanese Paper Industry

The Norwegian Legation in Tokyo reports that the plans which have long been under consideration for the amalgamation of the three largest paper manufacturing undertakings in Japan have now taken a firmer form. The concerns are the Oji Paper Manufacturing Co., the Fuji Paper Co. and the Karafuto Co., all of which are stated to be in a very good position, because, among other matters, the fall in Japanese exchange has hampered the import of foreign paper. It is assumed that the Oji Paper Co. will be the central unit in the combine, as the company holds a large block of shares in the Fuji Company. If the scheme is carried out, the total capital of the new undertaking will be about Y.345,000,000.

The merger is mainly, it is said, for the purpose of rationalization as it is proposed to close thirteen of the mills altogether, and so save Y.20,000,000 a year in working expenses. Also, quite frankly, the promoters confess that they are not going to have any more competition, but will raise prices for domestic consumption, and promote exports. One of its chief ambitions is to make rayon pulp. There is already some on the market, but it is uncertain yet whether the art of making a standardized silk pulp that will be the same every time has been mastered.

There is a curious difficulty experienced in the Japanese newsprint, says a correspondent of the *London Chamber of Commerce Journal*. That made entirely of Japanese pulp cannot be run at the full speed of a modern printing machine, so, though it is all right for the smaller newspapers, those which approach the million mark have to calculate very carefully the cost of output in relation to speed, to see whether the cost of imported pulp for strengthening the paper is recovered in the higher speed at which it can be printed. It is also one of the considerations that has to be taken into account in calculating the cost of going over to the "offset" system of printing, which is becoming increasingly popular in Japan. Should the experiments in producing rayon pulp be completely successful, it will mean that sales of 40,000 tons a year to Japan will have to find other markets.—*Paper Trade Review.*

Aviation in Japan

By EISABURO KUSANO

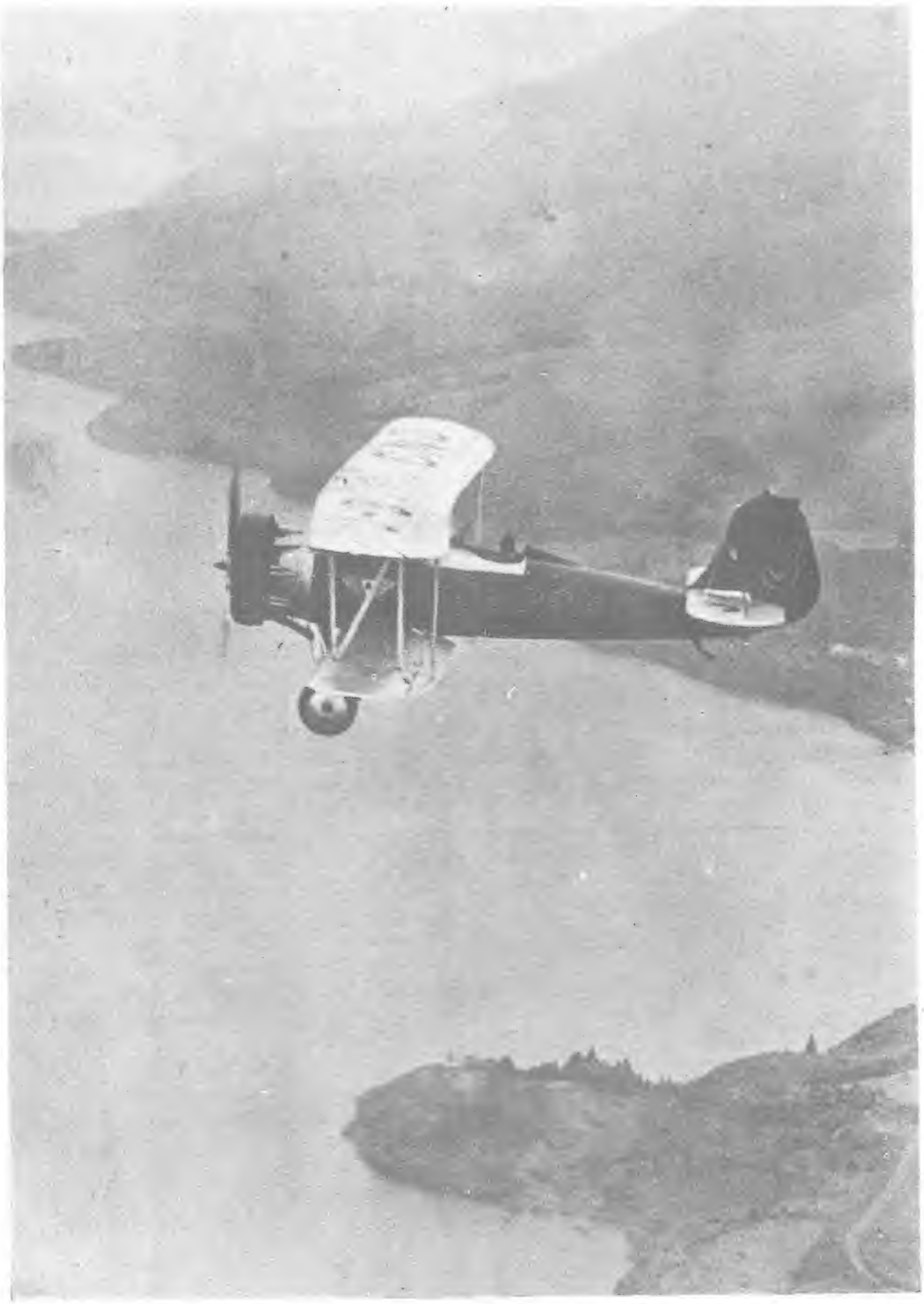
A NEW phase of progress in Japan's commercial aviation will be inaugurated in October, 1933, when the Japan Air Transport Company will open the regular night air mail flights between Tokyo and Osaka, a distance of 425 kilometers.

This is preliminary to the commencement in 1934 of the night passenger service between Tokyo and Tachiarai, a distance of 930 kilometers, after one year's practical experiment. If and when this program is materialized, a traveller leaving Dairen at 8 a.m. will arrive at Tokyo at 9 p.m., the same day.

The night air mail was to start on August 1, 1933, on the entire Tokyo-Tachiarai stretch but it has been postponed due to various technical difficulties, including the delay in the construction of the special airplanes and the air beacons. The aviation authorities of the Communications Department and the airline leaders met in a conference on August 21, this year, as the result of which it was tentatively decided that the long projected night air mail should begin in October, first between Tokyo and Osaka, and then extend the line to Tachiarai.

The night air mail service is to be conducted by operating eight special landplanes, remodelled from the 90-type No. 2 naval reconnaisance seaplane, mounted with a Jupitor 420 h.p. engine, and the Nakajima Aircraft Works is the builder.

Fourteen aviators of the Japan Air Transport Company, chosen to do the night flights, have been practicing take-offs and landings since April 13, 1933, at airports in Tokyo and Osaka. Meanwhile the Aviation Bureau of the Communications Department has been building 38 air beacons between Tokyo and Tachiarai. These lights are classified into three grades in accordance with their importance. The first class beacons are equipped with from 3,500,000 to 3,800,000 candle power light, while the second and the third grade lights have 3,000,000 and 2,000,000 candle power, respectively.



One of the airplanes the Japan Air Transport Company will operate on its proposed Night Airmail Service between Tokyo and Tachiarai. It is remodelled from the 90-type No. 2 Naval Scouting Plane, built by the Nakajima Aircraft Works. It was photographed on its way from Tokyo to Osaka over Lake Biwa

Two New Airways

The Communications Department plans to open two important airways during the fiscal year 1934-5 provided that the budget estimates therefor are approved at the next session of the Diet. One is the Fukuoka-Taihoku Line and the other is the Tokyo-Sapporo Line.

Experimental flights between Tachiarai, Kyushu Island, and Taihoku, northern end of Taiwan (Formosa), conducted in 1932, indicated sufficient practicability of operating this trans-oceanic line. And, the Communications Department has drafted a bill requiring Y.8,800,000 which is to be spent on this line over a period of 10 years. Of this total, Y.2,500,000 is designated to be disbursed by the Taiwan Government and the remainder of Y.6,300,000 is to be obtained from the fund hitherto reserved for the inauguration of the Fukuoka-Shanghai line.

Apart from the foregoing budget of Y.8,800,000, a disbursement of Y.2,000,000 is contemplated to establish and equip a new Fukuoka airport. The construction work is to begin in 1934 to be completed in three years. In building this new Fukuoka airport, special attention is being paid to traffic and communications with the present Najima airport.

As regards the Tokyo-Sapporo Line: the airport of Sapporo, in Hokkaido, as well as two by-way stations on the Main Island, at Sendai and Aomori, were completed early in 1933 as part of unemployment relief enterprises. All that is necessary now is to operate airplanes on this line. It is understood that the line will eventually be extended to as far north as to Karafuto (southern half of the Saghalien Island).

New Airports Completed

Five municipal or prefectural airports have been recently completed in Japan. They are:

(1) Kanoya airport, Osumi province,

Air Beacon erected at Chita Peninsula, Aichi Prefecture, between Tokyo and Osaka

Air Beacon built on the summit of Mount Ikoma, near Osaka

built and operated jointly by Kagoshima Prefecture and Kanoya (town).

(2) Ueda, Nagano Prefecture, built and operated by Nagono Prefecture and Ueda Municipality.

(3) Toyama, built and operated by Toyama Prefecture and Toyama Municipality.

(4) Ojiya, Kita-Uonuma-gun, Niigata Prefecture, built and operated by Niigata Prefecture.

(5) Niigata, built and operated by Niigata Prefecture and Niigata Municipality.

The Municipal airdromes now under construction at Nagoya, Hiroshima, and Kanazawa, are scheduled to be completed before long, while the city of Matsue has recently completed an airport for seaplanes on the southern shore of Lake Shinji.

To Organize Commission

The Communications Department proposes to organize an Air Commission, members of which will be selected from among the experts of the Communications, Railway, War, Navy, and Home Offices. Influential private individuals will also be included. It is with the realization of the fact that remarkable enthusiasm for aviation has been shown by the public and that it is necessary to control effectively all the air transportation facilities so that they may not only serve the ends of national defence in time of need, but in order that they may work in unison with steam and electric railways and motor-car routes.

The Ikoma Air Beacon

Salient points of the enterprises to be carried out by the projected Air Commission are:

(1) To complete air links between principal cities of the Empire by light planes through Government encouragement of the manufacture and operation of such craft among private concerns.

(2) To establish more airports and flying fields, air beacons, and aerial radio stations.

(3) To fascilitate transmission of short wave radio beams by numerous broadcasting stations in the country.

(4) To realize with the least possible delay air transportation between the main island and Taiwan and between Shimonoseki and Fusan. In such service, planes large enough to accommodate 50 to 60 passengers will be used.

Commercial Aviation in China*

THE first attempt to establish civil aviation in China was made in 1919. In that year contracts were entered into by the Government with the Handley Page Co. for six passenger planes, and with the Vickers Vimy Co. for 40 commercial, 40 training and 65 Avro planes. These, it was laid down, were to be used for commercial purposes only, a number of foreign experts and fliers were engaged, and an aviation school opened in 1920 at Nanyuan near Peiping. Elaborate schemes were drawn up for a network of air services, but these were wrecked by the state of chronic civil war that existed. All the first lot of planes were seized by various militarists, and a smilar fate befell most of those subsequently imported. Passenger and air mail services were intermittently maintained between Peiping and Peitaihao and Peiping and Tsinan, and that was all that was achieved until 1929.

In that year the first regular air service was inaugurated. The Ministry of Communications started one which was intended to run between Shanghai and Chengtu, but this in actual practice never went further than Nanking. China Airways, an American company, also maintained a service between Shanghai and Hankow, following the line of the river, on a contract basis for the Government-owned China National Aviation Corporation (Old Company). Loening amphibian planes were used, and a fixed rate paid per mile flown. The main business of both services was the carriage of air mail.

These two services in July, 1930, were combined as a result of an agreement between the Ministry of Communications and China Airways for the formation of the (New) China National Aviation Corporation, with an authorized capital of $10 million, of which the Ministry of Communications subscribed 55 per cent and China Airways 45 per cent.

Meanwhile negotiations had been going on which resulted in the formation of a second company. As early as 1928 the Luft Hansa of Germany had approached the Government on the subject of an air line between Nanking and Berlin, and on February 21, 1930, a Sino-German air mail contract was signed, and the Eurasia Aviation Corporation formed to carry it out, with an authorized capital of $3 million, two-thirds to be subscribed by the Chinese Government and one-third by the Luft Hansa. About $2 million of this have so far been collected.

These two companies represent all that is being done in China at the moment in the world of civil aviation. They are complementary to each other, not rivals, with different spheres of operation, and, to some extent, different aims, as their names to some extent indicate. The China National Corporation is more concerned with developing air communications within China, the Eurasia Corporation's main purpose is to establish a direct air service with Europe. The following details of the respective routes flown over by them will help to make this clearer.

I. China National Aviation Corporation

(1) *Shanghai-Hankow.*—This line was inaugurated in 1929 with a daily service except for Mondays. Stopping places and aerodromes are situated at Nanking, Anking, Kiukiang.

(2) *Hankow-Chungking-Chengtu.*—Inaugurated in May, 1931, this service at first only reached as far as Ichang. It was extended to Chungking in October, 1931, and to Chengtu in June, 1933. Two round-trips a week are made, with stopping places at Shasi, Ichang, Wanhsien, Chungking.

(3) *Shanghai-Peiping.*—Inaugurated January, 1933, with a tri-weekly service. Stopping places—Haichow, Tsingtao, Tientsin.

For a brief period—April to December, 1931—there was also a service from Nanking to Peiping.

It is hoped to start a new route this year (1933):

(4) *Shanghai-Canton*, with stops at Wenchow, Foochow, Amoy, Swatow, and Hongkong.

The Loening Amphibian Plane in service from Shanghai up the Yangtze

II. Eurasia Aviation Corporation

The first service opened by this company was

(1) *Shanghai-Manchuli*, May, 1931. This only operated a very short time, as the Japanese invasion of Manchuria forced it to be discontinued.

**The People's Tribune.*

Showing Type of Stinson Plane in service between Shanghai and Peiping

The Sikorsky Plane to be used in service between Shanghai and Canton

Type of Junkers W 34 All-Metal Plane used by the Eurasia Aviation Corporation on the 2,500 miles Long Route, Shanghai-Lanchow-Urumtschi-Chukuchak. Its power plant is a BMW-Hornet motor, 550 h.p. and it is equipped with Wireless, carrying one Pilot and one Wireless Operator. Its capacity is from six to eight passengers and its traveling speed is 130 miles an hour. This Plane made the flight from Berlin to Shanghai in five days

Meanwhile every effort was being made to overcome the difficulties that lay in the way of the company's primary object viz. the line to Berlin. Surveys were completed from Peiping to Tihwa and so via Russia to Europe, and from Shanghai via Nanking and Loyang to Sian, and

(2) *The North Western Line* began regular operation in December, 1932, with three sectional services:
   (*a*) *Shanghai to Lanchow* via Nanking, Loyang, Sian. Weekly service.
   (*b*) *Peiping to Loyang*, Fortnightly service.
   (*c*) *Lanchow to Urumtchi*, via Suchow, Hami. Fortnightly service. This last service, however, at the date of writing (June, 1933) was not in regular operation owing to trouble in Sinkiang.

As soon as possible a further extension will be made to Tchukuchak on the Russian border, where connection will be made for the time being with the Soviet air lines, and so with the general network of European lines. Later it is hoped to establish a direct service to Berlin. This will bring Berlin within six days of Shanghai, and possibly, if night flying becomes practicable, within four days.

Once this line has been got going it is proposed to inaugurate two others making Sian a junction for the company's services. These are

(*d*) *Sian-Canton* via Shiangyang, Hankow, Changsha.
(*e*) *Sian-Peiping* via Taiyuan.

Both of these lines are expected to absorb a large quantity of foreign mail matter.

In equipment and flying personnel the two companies are about on a par. The China National has in actual use only 11 machines, Six Loening amphibians and five Stinson planes. There are three in reserve and two on order. The only repair depot is at Shanghai (Lunghwa), though mechanics are stationed at Hankow and Chungking for emergencies. This company also maintains its own radio service and meteorological service, the latter the only one in China dispensing weather information suitable for aviation purposes. The Eurasia Corporation has in actual use at the moment only six planes, all-metal Junkers carrying four passengers, but a number of others are on order. Two in fact arrived in May this year, and one more is due in July. These three are six-passenger machines with a cruising speed of 130 m.p.h. The only repair depot is at Hungjao, Shanghai. The flying personnel of both concerns is almost entirely foreign. The China National employs eight Americans and one German as pilots, and two Americans and one Frenchman as assistant pilots. A Chinese flying staff is gradually being trained, and there are already a number of native assistant pilots. Eurasia employs six Germans, who are expected also to train Chinese apprentices.

Both companies depend on air mail for the greater portion of their business. The details as far as can be ascertained are as follows:

	Passengers	*Mail and Freight*
China National Aviation Corporation		
1930 (Oct.-Dec.)	3,008	48,014 lbs.
1931	2,296	75,742 lbs.
1932	3,153	111,872 lbs.
Eurasia Aviation Corporation		
1932	589	(9,758 kilos freight. (1,545 kilos mail.
1933 (Jan.-May)	221	figures not available.

From these figures it is clear that the China National does by far the more business. Not only has it more service and planes in operation, but it serves the more developed and populous areas. There is naturally far more demand in business circles for air transport facilities between Shanghai and Nanking and up the Yangtze valley and between Shanghai and the North, than between Shanghai and the backward undeveloped north-western provinces. At the same time these areas present far fewer topographical and kindred difficulties. It is easy for example in the Yangtze valley to organize stopping places with aerodromes and supplies of petrol and spare parts, since every point can be reached either by river or rail, if not by both. But flying north-west from Nanking one passes over some of the least developed parts of the country, where river, road and rail communication is practically non-existent.

The further one proceeds the more difficult the nature of the country flown over becomes, with high mountain ranges, desolate deserts, alternations of intense heat and cold, and sudden storms. Often machines have to climb to 13,000 feet and more and even then in places have to spiral along the mountain sides. Machines forced down in such a country have little chance. The pilot and mechanic for example of one which had to make a forced landing in Outer Mongolia were held prisoners for months.

Thus one great problem is the maintaining of depots with adequate supplies of petrol and other necessaries. These have to be carried long distances overland from one or other of the two railheads, Sian or Paotow, by motor truck, bullock cart or camel, an easy mark for bandits.

The Eurasia Corporation has had, too, by far the greater political difficulties to overcome. Save for that from Nanking to Peiping the China National has not had to suspend any of its services because of political disturbance. The only area where this factor has interfered with progress is possibly Szechuen, and not here to any great extent, if at all. The Eurasia Corporation has had to deal with Soviet opposition, and now that a settlement seems to have been reached there, trouble has broken out in Sinkiang, preventing the extension of the regular service to Urumtchi. For one thing the Company has not been allowed to set up the all-important radio service.

(Continued on page 424)

Penang Civil Aerodrome*

The Construction of the Landing Ground

By G. S. THATCHER, A.M.Inst.C.E.

THE urgent need for an aerodrome at Penang should require no explanation here. Indeed, the rapid development of civil aviation during the past few years has put Malaya quite "behind the times" until we have fully-equipped aerodromes to serve our principal towns, as well as frequent "emergency landing grounds" along the routes between them, in order to make the operation of this form of transport as convenient and as safe as possible.

In this paper the writer attempts to describe what has been done to date towards the establishment of this modern necessity in the "Northern Settlement."

For various reasons, mostly connected with commercial considerations, it was decided that the aerodrome should be situated on the Island of Penang rather than on the mainland opposite. The configuration of the ground, viz., a steep central range of hills surrounded by a narrow strip of flat coastal plain subject to floods, made the choice of a suitable place difficult; but after examining all the alternative locations, the Air Ministry's representatives eventually recommended the present site at Bayan Lepas, and it was acquired by Government towards the end of 1931 for the specific purpose of constructing an aerodrome.

All the Essentials

This area of 352 acres fulfils all the essential conditions for a Civil Aerodrome, although at first sight it may not appear to do so. It was in the first instance reasonably level throughout, it has a good approach from the air in almost every direction, and easy and rapid access by road from the town it is to serve. The only development of any magnitude or engineering interest that was necessary has been the provision of adequate drainage in order to render the landing ground free from flooding and hard enough to bear the weight of the heaviest aircraft in all weathers.

When acquired, more than half of this area was nothing but a swamp, old paddy fields neglected by their previous owners on account of drainage difficulties; the rest of it was occupied by a kampong of squatters' huts, each surrounded by its "cabbage patch," and a strip of land between the swamp and the kampong which had been newly planted with tapioca, coconuts and rubber trees. On the Eastern side the site included about 20 acres of secondary jungle and on the West it cut off a small portion of the old-established coconut plantation bordering the village of Bayan Lepas.

The squatters were induced to remove their huts to other sites in the vicinity early in 1932, and all trees within the boundary of the land acquired for the aerodrome have since been cut down and removed or burnt.

No extensive earthwork operations have been necessary in order to fit the landing ground for its purpose; only the smoothing out of the small local irregularities in its surface, and the removal of such minor obstructions as the existing drains and bunds. This was done in conjunction with the drainage, and the earth excavated from the large open ditches was transported and spread evenly over the landing ground area.

The soil throughout is alluvial mud, composed of a finely divided clay, a fair proportion of humus or decayed vegetable matter and a small percentage of sand. It has been cultivated intensively for many years, and is therefore ideally suited for the growth of turf. When the preliminary contour survey was made, the surveyors found the site very largely under water, but like most paddy land it gave a firm support to the feet just an inch or two under its muddy surface. The sub-soil drainage has since shown it to be quite porous, and surface pools quickly disappear after rain has ceased to fall.

In order to provide ample space for the alighting and taking off of heavily-laden commercial aeroplanes, the regulation size for a first class landing ground is "1,000 yards in every direction." It was therefore decided to make the Penang landing ground a circular one of that diameter; from practical considerations of drainage this shape is modified by the addition of two tangents at right angles to each other at the N.E. corner where the drainage outfall to the sea is situated, and as this distinctive shape is rigidly and permanently defined by a large open ditch (the "perimeter" ditch), it is readily and clearly visible from the air—an advantage which will no doubt be appreciated by visiting airmen.

The area of landing ground enclosed by the perimeter ditch is 175 acres, or half the total area of the aerodrome site. The other half surrounds the landing ground and forms a "clearance belt," with a minimum width of 200 yards; it is to be kept as clear of trees, buildings, or other obstructions as possible, and thus render the whole of the landing ground available for its specific purpose.

Three Objects

In designing the drainage of the aerodrome, the three primary objects were:—

(*a*) to collect storm-water as quickly as possible, and dispose of it towards the sea, i.e. to prevent flooding.

(*b*) to keep the water-table under the landing ground as low as possible during dry weather, in order to make the surface hard enough for its purpose and encourage the growth of thick turf with deep roots.

(*c*) to keep the tidal waters out of the drainage system. As the landing ground is only just above H.W.E.S.T., the entry of sea water would retard the growth of turf and introduce crabs; in addition by keeping out the tides, the reservoir capacity of the drainage system is increased.

Object (*a*) is the only one presenting any real problem, for during severe floods, the whole of the land surrounding the aerodrome is more or less awash, no matter what the state of the tide. The landing ground, however, at its lowest point, is just above highest recorded flood level for the district, so with the aid of the reservoir capacity of the open drains during high tides it is hoped to keep the aerodrome available for all-weather use. In this connection it may be of interest to mention that the landing ground at Alor Star is often water-logged to a depth of one or more inches, without any appreciable lessening of its effectiveness.

Drainage System

The drainage system at Bayan Lepas therefore comprises:—

(*a*) the large open "perimeter" and "reservoir" ditches, into which discharge—

(*b*) a network of sub-soil drains under the surface of the landing ground

(*c*) a tidal gate, in conjunction with the outfall culvert across the Batu Maung Road.

The only outlet available for this drainage system is the tidal stream along the Batu Maung Road. The distance from the outfall culvert along this stream to the sea is about one mile, and the lowest practicable invert level at the culvert is such as to give a fall of only 1 in 3,500 to low water mark. Allowing a 6-in. cill for the tidal gate, the invert of the lower end of the reservoir ditch was thus fixed, and from this the open drains were given a gradient of only in 2,600, in order to provide the maximum possible depth for the sub-soil drainage.

The Glenfield and Kennedy tidal gate, is a simple cast iron sluice gate sliding vertically in a frame of the same material, and operated by a handscrew. It has a clear width of 4-ft. when open,

*Quarterly Journal of *The Quarterly Journal of The Engineering Association of Malaya*.

and its height is 7-ft. above the cill, sufficient to keep out the highest spring tides. Its frame is firmly supported by and encased in an extension of the concrete abutments of the outfall culvert, which is a simple reinforced concrete structure with the same cross-sectional dimensions as the opening of the tidal gate.

The large open ditches have an average depth of 7-ft., and the sides are cut with a slope of 1 to 1½ ; the average width at the ground surface being 50-ft. and 25-ft. for the "reservoir" and "perimeter" ditches respectively. The side-slopes, wherever the ground is particularly soft or friable, have had to be supported by simple revetments formed of hard wood planks, held in place by bakau piles driven into the ground at 3-ft. intervals. In the majority of these weak sections it was found necessary to provide two rows of revetments, one at the root, and the other at the middle of the slope. The sides of these ditches are to be turfed, and this is now being done in conjunction with the turfing of the landing ground.

Sub-soil Drainage

The reticulation of the sub-soil drainage is divided into eight distinct sections by eight main collecting drains which radiate from the center at 45° intervals and discharge into the "perimeter" ditch. The advantage of this arrangement is that only one-eighth, or even less, of the landing ground area will need to be isolated in the future as temporarily "out of order," in case one of the pipe lines should become blocked or broken. These main radial drains are made with 6-in., 9-in. and 12-in. pipes according to the number of branch drains discharging into each section. These branch, or "herringbone" drains are connected to the radial drains at an angle of 45° and form a network covering the whole area of the landing ground ; at present they are spaced 200-ft. apart, but provision has been made for an ultimate spacing of 50-ft. (if required) without disturbing the radial drains, by the incorporation in the latter of sufficient extra junctions, which until required for use are rendered "blind" by the insertion of precast cement plugs. The reason for this is that, owing to the nature of the work, it cannot be foreseen how close the sub-soil drains will eventually have to be spaced in order to make the ground suitable for use by aircraft ; the spacing may perhaps have to be closer in some sections than in others, owing to slight differences in the soil.

The minimum depth of the sub-soil drains below the ground surface is 3-ft. and the maximum 6-ft. 6-in. They are laid to uniform gradients of 1 in 400 in the case of branch drains, and 1 in 750 for the main radials. These slopes are flatter than the ideal, but they are the best that the conditions at the site would allow, and in practice they have been found to function satisfactorily.

The branch drains are all made with 6-in. diameter sub-soil pipes (sometimes called "agricultural drain pipes" or "pipe-tiles") laid as closely as possible, end to end, on a foundation of broken stone, size 2-in. to dust, which averages 3-in. in depth and 18-in. in width. This stone also acts as a "filter"—it helps to prevent particles of earth from entering the pipes, and increases considerably the "area of collection" of the joints, through only the lower half of which water is permitted to enter the pipe-lines ; the upper half of each joint is closed with a strip of ordinary sheet rubber 2-in. wide protected by a covering of puddled clay.

The main radial drains are laid in a similar manner to the above, except that the four longer (alternate) radials are constructed with glazed pipes, partly as an experiment to show the comparative ultimate wear-resisting properties of glazed and unglazed pipes, and partly because the former, being longer, and on account of their socketed joints, are more likely to keep their position and maintain their gradient under adverse conditions such as uneven settlement of the ground, aircraft landing shocks, etc. Spunyarn was caulked into the sockets, and the upper half of the joints was closed with puddled clay. It is expected that the soil surrounding these main drains will have reached final consolidation before the spunyarn rots away, and the lower half of the joints will then function as in the case of the butt ended pipe tiles.

The soil excavated from the trenches was back-filled as soon as the pipes were laid and inspected. As it was feared that it might not prove to be sufficiently porous to drain the surface of the ground after rain, the original specification provided for this contingency by the inclusion of a red-earth back-fill, to be imported from a hillside about two miles away. Experiments with the first pipes to be laid, however, proved that the site-soil was as porous as red earth, while a sand back-fill, though the best of all, was too expensive to be practicable.

Little Use in Wet Weather

It should be emphasized here that the chief function of the sub-soil drainage is to lower the water-table of the landing ground during dry, or comparatively dry, weather ; by soaking away the water "slowly but surely." It is of little use in wet weather when the bulk of the rain water flows over the surface of the saturated ground. The open ditches are therefore the chief safeguard against flooding of the landing ground, and as the whole problem of the aerodrome drainage is not amenable to calculation, the treatment is necessarily one of "trial and error." Thus, it may be found necessary to widen the "reservoir" and "perimeter" ditches in order to increase their reservoir capacity, though, this is not considered likely in the light of experience gained at the site during the past year. Incidentally it may be of interest to record that while the permanent outfall tidal gate is 4-ft. wide and 7-ft. high, a temporary wooden flap gate only 3-ft. square, in an earth cofferdam placed across the end of the reservoir ditch, dealt quite satisfactorily with the drainage of the aerodrome until the end of January of this year, when the cast iron sluice gate was erected, on its arrival from England.

The excavation of the reservoir and perimeter ditches, together with the cleaning and levelling of the site, was commenced in March, 1932. The sub-soil drainage was begun about a month later, as soon as the work on the open ditches had progressed far enough to provide an outfall.

All the above items were included in one contract, which owing to the default of the contractor, had to be determined on July 26, 1932, when the work was split up into sections and either given out to minor contractors or carried on by departmental labor.

Functions Satisfactorily

The open ditches and the sub-soil drainage were completed in November, 1932, since when observation of the ground during first a very wet spell, and then a long dry one has shown that the system functions satisfactorily. After five weeks without rain, the surface of the landing ground was closely covered with cracks, as the soil shrinks considerably when dried. Trial holes, however, showed that the dry cracked condition extended to a depth of only 12 to 18-in. ; below this the soil was still more or less saturated, proving that the dryness of the surface was due more to evaporation than percolation.

It has therefore been decided to lay more sub-soil drains so as to reduce the spacing to 100-ft. This work will be put in hand as soon as the requisite pipes are made and delivered to the site; only one "section" will be opened up at a time, so that during the progress of the work, at least two "sections" will always be available as an emergency landing ground.

When this extra sub-soil drainage is completed, it is hoped that it will prove to be sufficient to make the ground hard enough for its purpose in all weathers. In any case, if it does not, a longer interval will be required for the observation of its effect on the ground, before it is decided to add further drains ; for the soil is expected to become more and more porous in course of time, as the vegetable content decays and shrinks on drying out ; and over-draining is to be avoided, as it might have an adverse effect on the growth of turf.

Turfing

The turfing and "conditioning" of the ground are of little or no engineering interest, but from the point of view of labor and toil they have proved to be the most arduous of all the operations connected with the construction of the aerodrome. In the first place, the marsh-grass which covered two-thirds of the landing ground area, was extraordinarily difficult to eradicate, and although the soil is an excellent one for the promotion of good turf, it has shown itself to be still more excellently suited to the growth of all kinds of stubborn-natured weeds.

It has not been necessary to import grass to the site, or to sow grass seeds, for several suitable varieties were found growing there ; these were propagated all over the landing ground by "stippling," and have spread rapidly, so that the greater part

(*Continued on page 406*)

Notes On Aerodrome Design*

By STEEN SEHESTED, B.Sc., M.I.Dan.C.E.

EDITORIAL Notes of the April number of the *Quarterly Journal* of the Engineering Association of Malaya stress the interest attaching to the special problems which encompass the design and construction of an efficient and safe all-weather aerodrome, and they express a hope that engineers in Malaya who have had opportunities of studying these problems in their theoretical and practical aspects should pass on to others benefit of their experience.

There can be little doubt that a new speciality has arisen in what is probably the most specialized profession in the world. The Aerodrome Engineer has come into being as an off-shoot of the Civil branch of Engineering, and in Malaya this new specialist is rapidly gaining in strength and numbers as more and more Public Works Department Engineers are drawn into this class of work. Members of the Engineering Association of Malaya have already benefitted considerably by the experience of these engineers as the result of visits to the new flying grounds in Singapore and Penang, and the future, no doubt, has very much more in store for them.

As a lay observer, the author has been struck by the fact that three of the flying fields of Malaya are square (Alor Star, Taiping and Port Swettenham) whilst three are circular (Seletar, Singapore and Penang). Assuming that the length of the square and the diameter of the circle are the same, that is equal to the distance required for taking off as laid down for a first class flying field, the area in the former case is no less than 22 per cent greater than in the latter, (l^2 as against $0.78\ l^2$), without offering any apparent advantage in so far as flying is concerned. In view of the cost of land acquisition and the subsequent preparation of the ground itself an engineer is naturally led to speculate as to what constitutes the most economic shape of a flying field.

Conditions Governing Design

The conditions determining the shape of an aerodrome are the starting distance and the rising capacity of the machines; traffic requirements; and the existence of obstructions in the vicinity of the flying ground. For the purpose of these notes the rising capacity of the machines and possible obstructions in the vicinity of the ground are undetermined and must therefore be disregarded.

The only remaining conditions are starting length and traffic requirements. The latter are generally, that a machine should be capable of taking off whilst another machine is in the act of landing. When the field is turfed the starting distance is always considerably greater than the landing distance. In America the starting distance has been reduced by concrete paving, but in addition to this, special runs are used for landing on which the landing distance is reduced by oil treatment of the surface, so that here also the starting length remains the greater of the two. Taking an average of the requirements of different countries, it will be found that a first class flying field must have a length of 1,000 meters in all directions, and a minimum width of 400 meters. This width of 400 meters which allows for simultaneous taking off and landing, is only required for a length of 600 meters, the amount by which the two processes overlap. For the rest a width of 200 meters is generally considered sufficient. As both starting and landing take place against the wind, the flying field must generally circumscribe in all directions the figures specified above.

This, at least, is the case in Europe, and these notes are based on this assumption. It may be mentioned however that in America, flying fields with pronounced prevailing winds are often rectangular, whilst the strength of winds habitually blowing from certain directions has also influenced their shape and has even resulted in the adoption of considerable deviations from the normal wind direction when taking off.

The Triangle

The simple geometrical figures satisfying the conditions laid down are not exhausted with the square and the circle. The equilateral triangle with a height equal to the starting distance (i.e. 1,000 meters) can claim consideration. The area is only $0.58\ l^2$, but as it has to be increased appreciably in widening the corners to allow of a rectangle being inscribed, the final shape is similar to, although not as economical as, that of a flying field designed on one of the principles discussed below, and it will not be further enlarged upon here.

The Asteroid

Frederik Schultz† has examined the Asteroid as a possible figure for a flying field. The Asteroid is generally formed by rolling a circle around the inner periphery of another circle of four times its diameter. For the purposes of these notes the curve can be developed by sliding a line of length l along the axes of a co-ordinate system, the branch of the curve falling within one quadrant being shown in Figure 1. A field of this description would allow landing with the wind blowing from any direction in the two adjacent quadrants. To allow for winds in the quadrant shown and its opposite, the branch of the asteroid in one or other of the two adjacent quadrants must be used. The most advantageous way of placing this branch is shown in Figure 2. The two areas cover each other to a certain extent, whereby space is saved. The cover might be greater but for the fact that it is not sufficient to allow a line to slide on the two axes. A rectangle is used in the performance of this operation which produces curves parallel to the arcs of the Asteroid. When selecting such curves as pass through the center of the square it is found that the rectangle to be used is $0.2\ l$ wide, or exactly what is required in width for taking off. A closer examination

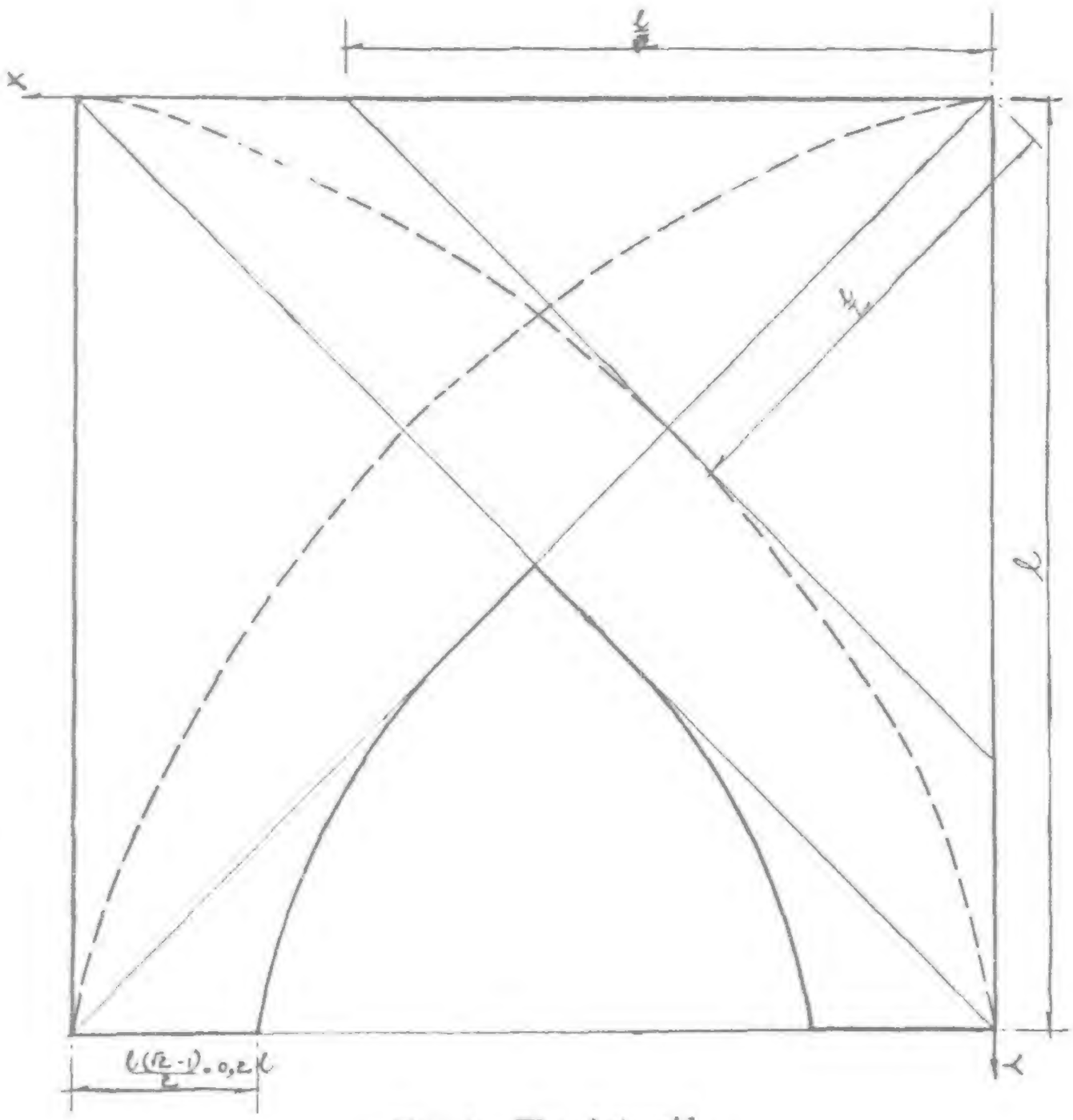


Fig. 1.—The Asteroid

*Quarterly Journal of *The Engineering Association of Malaya*.

†In *Ingenioeren*, Copenhagen, October 8, 1932.

shows that the enclosed area in every direction provides a space of 600 by 400 meters so that the requirements for simultaneous landing and taking off are also satisfied. In one direction the width is actually 500 meters for a length of 1,090 meters.

The area of the Asteroid is $0.474\,l^2$, and adding the space between the Asteroid and the parallel curve the area of the flying field is very nearly the same as that of a circle, that is about $0.78\ l^2$. The two fields cannot, however, be compared without some qualification. The Asteroid aerodrome of 1,000 meters actually provides a maximum taking off distance of 1,400 meters, whereas an l of 700 meters would provide the same maximum as a circular field of 1,000 meters diameter.

The Hypocycloid

Schultz suggests that Steiner's Hypocycloid probably represents the geometric figure yielding a minimum area. This Hypocycloid is shown in Figure 2. It has three apeces and is formed by a circle rolling within another circle of three times its diameter. Steiner was the first to prove that a line of a length equal to $4r$ sliding on two of the branches of the curve forms the third one, by which the suitability of the curve as an outline for a landing ground is proved. Using a rectangle instead of a line, the outline of the field would be as shown in Figure 3. Rectangles $2a \times (4r + a)$ can be inscribed in this field, so that in drawing Steiner's curve the r used should be equal to $\frac{1}{4}\,(1-a)$.

The area of Steiner's Hypocycloid is $0.39\ l^2$. Adding the surrounds of width a, the area of the flying field is approximately $0.67\ l^2$. A comparison between this flying field and a circular one presents the same anomaly as for the Asteriod,—that is this triangular flying field offers advantages beyond those offered by the circular field if based on the same l.

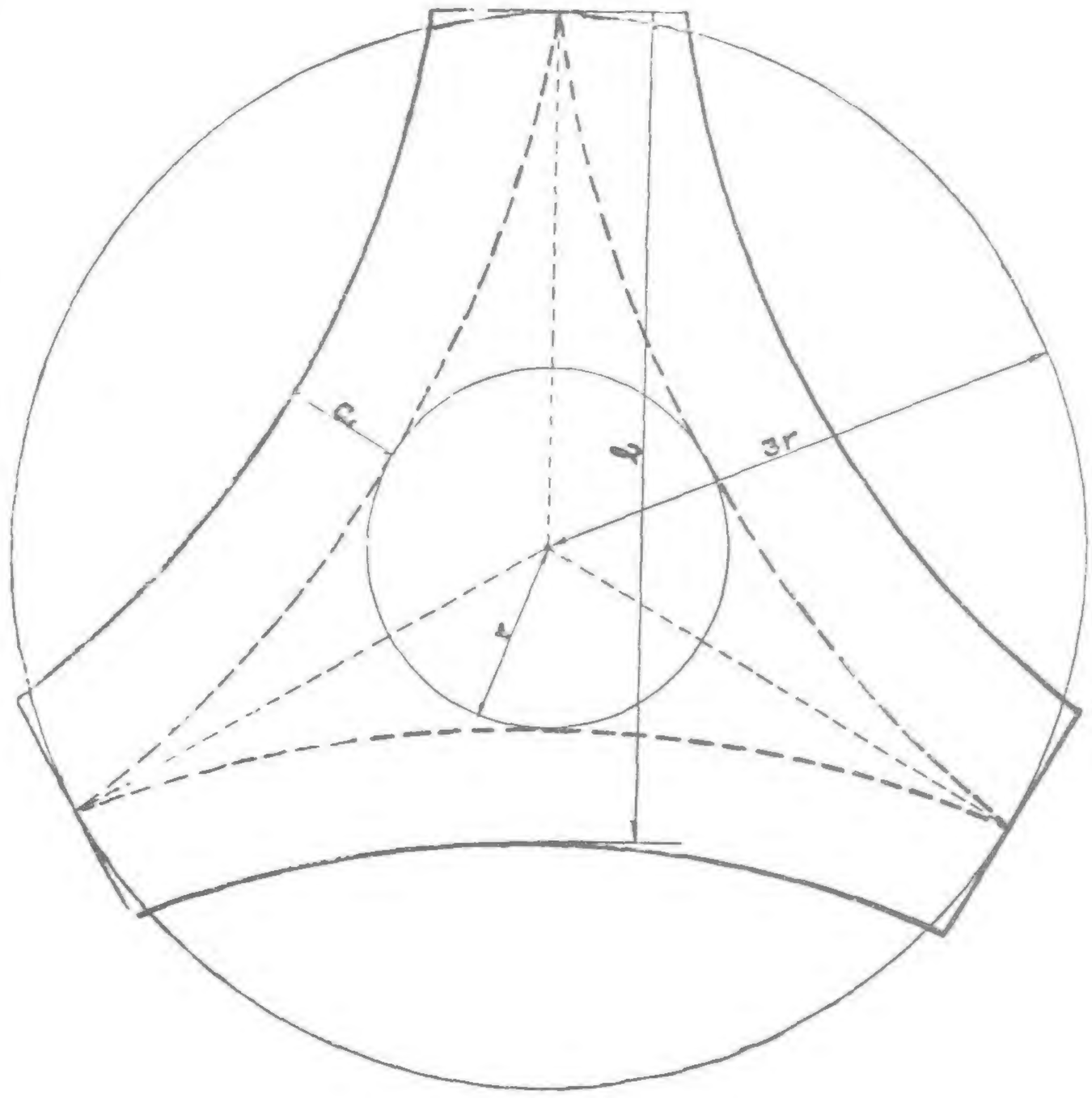


Fig. 2.—The Hypocycloid

Relative Savings

Schultz states that using the same minimum effective flying lengths and widths the saving in space is 1 per cent and 14 per cent for the Asteroid and the Steiner curve respectively compared with a circular field. When using the same maxima these figures become 50 per cent and 36 per cent respectively. He considers that a field of either of the two forms 25 per cent smaller in area than of a circular field would offer all the advantages of the latter.

Disposition of Buildings

The Asteroid flying field would generally be placed with the greatest width in the direction of the prevailing wind. Buildings would be situated in the cut to the right, which would offer the advantage that no flying over roofs need take place in any case, whilst in calm and hot weather there would be available an additional distance for taking off. American flying fields of this type have been constructed, probably for practical reasons which have had nothing to do with the considerations set forth above.

Taking a flying field formed on the principle of Steiner's Hypocycloid, the buildings would be best placed opposite the branch which lies in the direction from which the wind is least frequent.

In closing these observations it is only appropriate to state that there are some reasons which speak for the wasteful square flying field. In many cases it fits best into existing boundaries; it can at any time be transformed into a circular or octagonal field by building over the corners; finally it does offer some advantages for flying uses by providing, admittedly to excess, additional starting length along the diagonals.

Penang Civil Aerodrome

(*Continued from page 404*)

of the area is already fairly well turfed, and the Ransome "Gang" mower of five units has been in use for the past two months.

A "Pattison" tractor is used for towing these mowers, and also for the three light rollers, which are coupled together by means of an angle-iron frame. These rollers are made from old 12-in. diameter cast iron water pipes, 6-ft. long, and filled with coarse concrete.

The levelling and "conditioning" of the surface of the landing ground has been, and still is to a lessening extent, a toilsome operation; for whether due to the effect of the sub-soil drainage, evaporation, or unequal decay in the vegetable content of the soil, no sooner has any section been made level and smooth than it at once begins to develop mysterious "bumps" and in a few weeks it is almost as uneven again as ever it was. This state of affairs, however, is now improving, but still gives employment to about thirty or forty coolies daily.

Although the landing ground is not yet officially "open" for all-weather flying it has already seen its first aeroplane. A "Puss" Moth belonging to H.H. Prince Ali Khan, who was making a tour of the East, came from Bombay via Rangoon, and alighted at Bayan Lepas on the evening of January 11, last. It was during a dry spell (there had been no rain for a month) and the pilot expressed the opinion that the condition of the ground at the time was very satisfactory.

Much has yet to be done before this landing ground now under construction can become a fully equipped aerodrome; hangars, repair shops, waiting rooms, customs sheds, etc., will no doubt be erected in the future, but they are beyond the scope of the present paper; this therefore concludes the description of the work done to date on the construction of the Penang Aerodrome. For the sake of brevity many details have had to be omitted, but it is hoped that the information given above will serve to create further interest in this as yet comparatively little known subject among engineering circles in Malaya.

Modern Traction in Siam and Manchuria*

With Diesel Locomotives

A SPECIAL number of the *Sulzer Technical Review* is mainly devoted to the Sulzer Diesel locomotive for express and good strains and shunting purposes, and to the Diesel electric rail car. In this connection the acquisitions in recent years of the Royal State Railways of Siam and of the South Manchurian Railway receive special attention.

Diesel traction has long passed the experimental stage, and in the last five or six years has been successfully adopted in many countries and by some on a large scale. Hitherto, economical and technical conditions have had much to do with limiting the adoption of Diesel locomotives to special cases. Owing, however, to the progress in engine design and construction the technical difficulties have been overcome, and as to whether steam, Diesel or electric traction is the most economical, there are a number of cases where Diesel is obviously favored by special circumstances. This holds especially in cases where water is scarce and in others where fuel has to be transported for long distances. In consequence of the low fuel consumption and the ease of transporting oil fuel, Diesel locomotives are in such cases essentially the more rational. Another particularly favorable case for Diesel traction is on so-called strategic railways.

The most important forms in which Diesel-engine traction has been adopted so far are for (*a*) shunting locomotives, (*b*) rail cars and locomotives for light railways or for branch lines, and (*c*) locomotives of medium power for main railways.

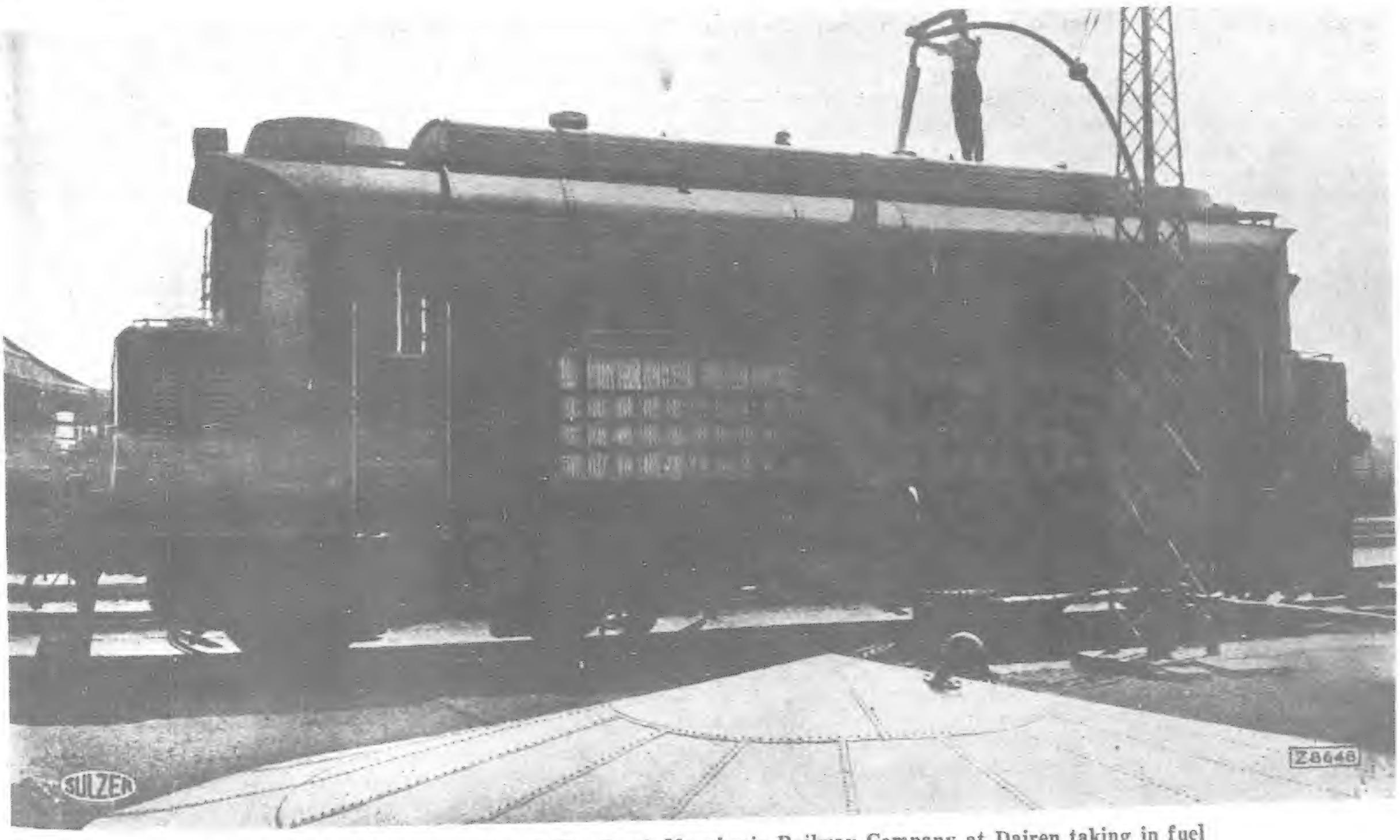
In the Far East the South Manchuria Railway has adopted the 750-1,000 h.p. Diesel engine for use in the first category, and Siam locomotives of from 450 to 900 h.p., the former for light passenger and goods traffic, and for shunting. The higher powered locomotives are for express trains of the Royal State Railways, whilst for heavy goods trains an experimental Diesel locomotive is being used. In the *Railway Gazette* of May 20, last year, the case was mentioned of one of these Diesel locomotives replacing four steam engines in Siam.

Summing up, the writer of the article in the *Sulzer Review* states :—It has been shown that it is now possible to construct Diesel locomotives of any required output, so that Diesel traction is technically on an equal footing with electric and steam traction. By this it is not intended to imply that Diesel traction is under all circumstances superior to other systems as regards economy ; it will, however, take an important place in railway communications. Just as an elevated or underground railway, tramway, trolley or petrol omnibus, has each its particular place in the traffic of a town and in the suburbs, so may steam, electric or Diesel traction be adopted for main railways, according to the density of traffic and the extent to which the time-table allows the vehicles to be utilized, unless local conditions, such as lack of water or fuel, make one or other of the systems preferable. Express train traffic over greater distances with powerful locomotives is a type of service for which the Diesel locomotive could be adopted with particular advantage, since fuel consumption is responsible for a greater percentage of the total working costs in such service more than in any other.

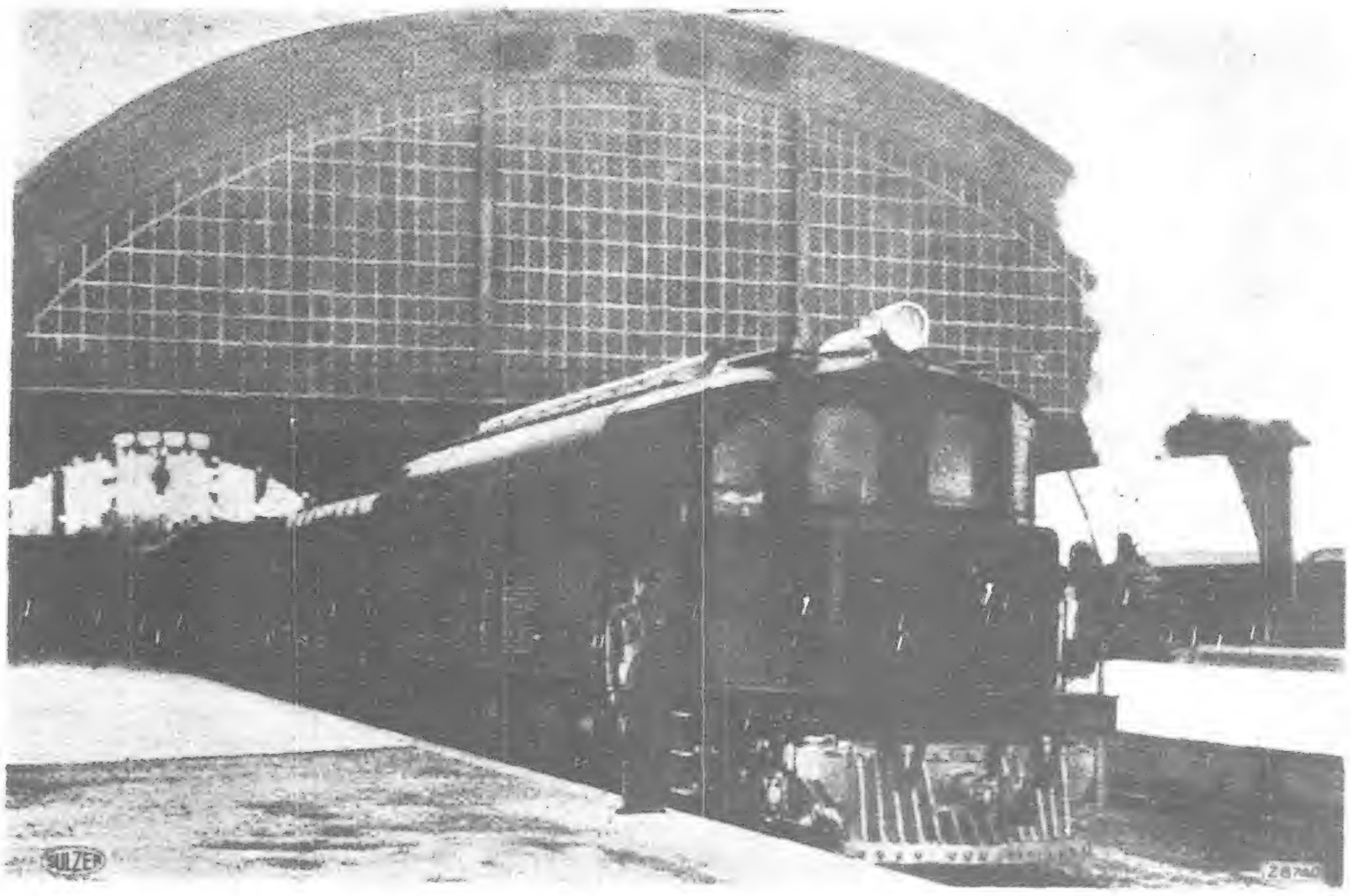
It is to be expected that the cost of producing oil from coal by means of low-temperature carbonization will gradually be reduced. Consequently, countries producing coal will, in a reasonable time, be in a position to produce Diesel engine fuel oil at competitive prices, so that also in these countries, where there is an abundant supply of cheap coal, Diesel traction will unquestionably be advantageous.

The six or eight-cylinder four-cycle Sulzer Diesel engine specially developed for traction consists of one block of six cylinders or two blocks of four cylinders each, bolted together. The principal frame of the engine is of cast steel, the connecting rods are of chromium-nickel-steel, and the pistons of aluminium. Owing to the adoption of these special materials the total weight, and especially the weight of the moving masses, has been kept low.

**Eastern Engineering and Commerce.*



750 b.h.p. Shunting Locomotive of The South Manchuria Railway Company at Dairen taking in fuel



450 b.h.p. Sulzer Diesel Locomotive in the Station at Bangkok

The Diesel engines in the rail cars and locomotives work with direct airless injection of fuel on the pre-combustion chamber principle, the pressure necessary for complete atomization of the fuel being obtained through partial combustion of the fuel in the pre-combustion chamber. Good results have also been obtained recently without the pre-combustion chamber.

Each cylinder has its own fuel pump, which is arranged between the push rods of the inlet and exhaust valves of the cylinder; the pump is direct driven from the main camshaft and delivers the fuel into the pre-combustion chamber. The quantity of fuel delivered is automatically adjusted to suit the required output of the engine by means of a centrifugal governor which keeps the engine running at a constant speed.

In order that the Diesel engine may fully satisfy the conditions of service operation, it is designed for three different speeds, which can be chosen as desired from each cab. The starting and stopping of the Diesel engine is also effected from the cabs. The engine can be stopped when the locomotive is coasting or standing at a station, and can be started again when required within a few seconds. This arrangement allows a considerable saving in fuel to be made, as compared with an arrangement where the engine is running continuously.

Diesel engine and generator are rigidly coupled to each other. The auxiliary generator, which supplies current for the various auxiliary machines and also serves for exciting the main generator, is also coupled to the main generator, and therefore runs at the same speed. The whole set rests on one common auxiliary frame constructed of steel plate and rolled sectional iron, which is mounted on the frame of the locomotive.

The principal circuit connects the main generator to the series-wound traction motors, which work in parallel. By means of the controller fitted in each cab, resistances arranged between the auxiliary generator and the field of the main generator are switched in and out. This makes it possible to change the tractive effort to suit requirements.

By means of the simple arrangement of the controls and their gear, it is possible for one man to attend to the locomotive. In addition, fuel delivery to the Diesel engine, and also its lubrication and cooling, are entirely automatic, so that no special attendant is required for the engine.

The engine is started by means of the main generator, which is provided with a special winding and works as a motor during the starting period, receiving current from a storage battery.

The traction motors are of the nose-suspension type, and are generally self-ventilated; their torque being transmitted to the axles through reduction gearing. Each motor is equipped with a remote-controlled contactor and a maximum current relay. By means of a reversing switch, which can be operated from the cab electro-pneumatically, the traction motor fields are reversed in order to change the direction of running of the locomotive.

The auxiliary generator supplies the current for the various auxiliary machines and starting battery, and also for exciting the main generator.

The auxiliary machines that have to operate when the locomotive is running with the Diesel engine at rest or during halts, such as the motors of the vacuum pump and auxiliary compressor, may also be connected to the accumulators if required.

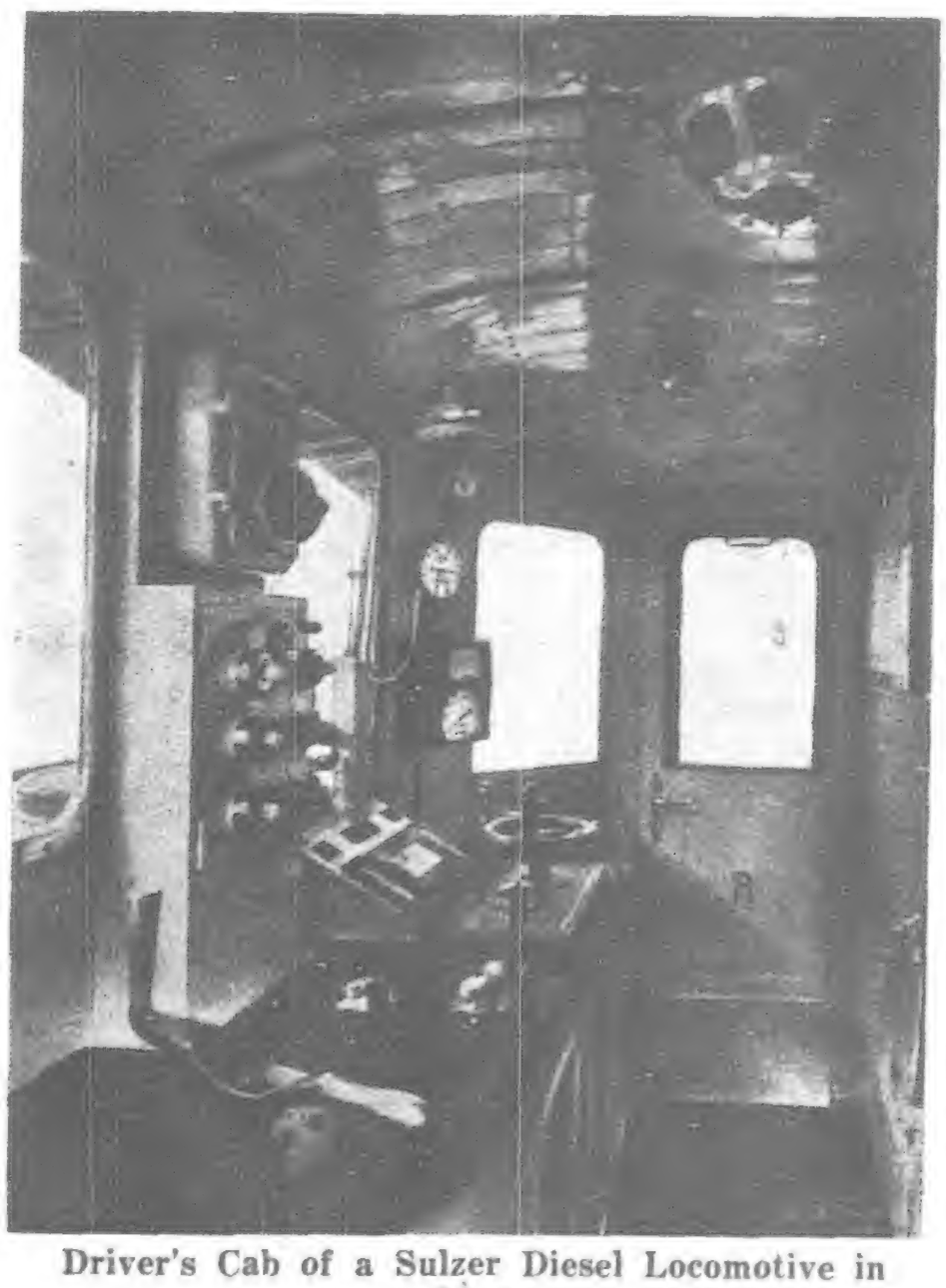
The iron-nickel accumulators are generally situated in the front and rear sections of the locomotive. In the rail cars they are placed under the frame, or at some convenient spot inside the vehicle. The charging contactor, between the auxiliary generator and the battery, closes the charging current circuit automatically as soon as the auxiliary generator voltage rises above a certain figure. A return-current relay breaks the circuit when the voltage at the terminals of the auxiliary generator is less than that of the battery.

The fans of the coolers are driven by series motors connected in parallel to the terminals of the auxiliary generator. These motors are not connected to the accumulators, since they have only to work when the Diesel engine is running. They start automatically when the engine is started.

The cooling-water pump is driven by a series motor which also comes into service automatically as soon as the engine is started. When the engine is at rest, the cooling-water pump may still be kept running by means of a switch fitted in the cab. This makes it possible to continue cooling the Diesel engine after it has been stopped.

The current for the interior and exterior lighting of the locomotive is supplied by the battery of accumulators, and the intensity of the searchlight can be varied by means of a dimming resistance.

In each cab there is a controller by means of which the excitation of the main generator is altered. A switch is provided for running forwards or backwards, which is connected with the speed adjustment of the Diesel engine, and there is also a starting and stopping switch for the engine. In addition, in each cab there is a switch for the vacuum pump and one for the cooling-water pump. The following instruments are also provided and are arranged so that they can easily be read by the driver:—A tachometer, showing the speed of the Diesel engine; a wattmeter for the output of the main generator, and an ammeter for the traction motors. By means of the first two instruments the driver can see if the engine is running normally. If, however, for any reason



Driver's Cab of a Sulzer Diesel Locomotive in Siam

one or more cylinders should misfire or be cut out during service, which may happen owing to failure in delivery of fuel, the governor will cause the load to be distributed over the other cylinders, which are consequently overloaded. This is soon observed, as an additional instrument is fitted in the cab to show the lift of the governor, and at once indicates any irregularities in the working of the engine. The same apparatus also contains an indicating device to show if the cooling-water and lubricating oil are circulating normally.

In each cab there is also an instrument to show the speed of the locomotive ; one of them is of the recording type.

South Manchuria Railway

At the end of 1930 Sulzer Brothers, Winterthur, delivered a 750 b.h.p. Diesel-electric locomotive to the South Manchuria Railway Co. The locomotive is used for shunting service in the port of Dairen and also for hauling mixed passenger and goods trains on the company's main lines.

The locomotive was designed and all drawings prepared by Sulzer Brothers, Winterthur, who also built the Diesel engine. The supply of the electric part was confided by Sulzer Brothers to the Ateliers de Construction, Oerlikon, and that of the mechanical part to the Société Industrielle Suisse, Neuhausen.

The following are the principal data :—

Gauge	1,435 mm. (4-ft. 8½-in.)
Length	12,300 mm. (40-ft. 4-in.)
Distance between bogie pivots	6,760 mm. (22-ft. 0-in.)
Wheel base of bogies	2,500 mm. (8-ft. 2-in.)
Number of axles	4
Number of driving axles	4
Diameter of driving wheels	1,120 mm. (3-ft. 8-in.)
Service weight of locomotive	80 tons
Adhesion weight	80 tons
Sulzer Diesel engine	8 cylinders
Output (continuous) of the Diesel engine at	
620 revs. per min.	750 b.h.p.
530 revs. per min.	640 b.h.p.
440 revs. per min.	530 b.h.p.
Maximum tractive effort at starting	16,200 kg. (35,650 lb.)
Tractive effort at 20 km. (12½ miles) p.h.	7,500 kg. (16,500 lb.)
Maximum speed of the locomotive with trailers	40 km. (25 miles) p.h.
Maximum speed of the locomotive alone	60 km. (37½ miles) p.h.
Minimum radius of curves	70 m. (3½ chains)

The locomotive is capable of drawing a load of 1,800 tons at a speed of 15 miles per hour on the level. Because of the load of 20 tons on each axle and to give the advantage of high adhesive weight for the shunting service for which it is intended, the locomotive is of fairly heavy build in proportion to its power.

The design of the Diesel engine and the system of electric transmission are already described.

The water for cooling the working cylinders and the cylinder covers is cooled in a closed circuit, being circulated through two coolers arranged at both ends of the locomotive. In order to increase the cooling effect, a fan is fitted behind each cooler to draw air through the end of the cooler and expel it again through an opening in the roof. These fans are driven by electric motors and can be run at various speeds in order that the cooling effect may be adjusted to suit the outside temperature. Special coolers are also fitted on the side walls of the locomotive for cooling the lubricating oil.

The auxiliary dynamo gives an approximately constant voltage of 150-volts at all three speeds of the Diesel engine. It is automatically connected to or disconnected from the battery of accumulators by means of a charging and a non-return relay working in conjunction with an electro-magnetically operated charging contactor. The battery consists of 96 iron-nickel cells, connected in series, with a capacity of 400 ampere-hours.

The motor compressor group for providing air for the brakes is designed for supplying 106 cub. ft. per min. at a pressure of 100 lb. per sq. in. It is automatically switched in when the pressure in the air receiver has fallen to 70 lb. and automatically switched out when it has again risen to 100 lb. per sq. in.

Each driver's cab is heated by a radiator and a footwarming plate, the necessary current being taken from the accumulators. The accumulators also provide current for lighting ; a small resistance is provided, by means of which the voltage of the current to the lamps is automatically reduced during charging, so that lamps for 100-volts can be used as stipulated by the railway company.

The driver's cabs contain the normal equipment already described.

The locomotive is fitted with automatic and non-automatic Westinghouse brakes and with a hand brake. The driver's brake valves and the triple valve are combined for the automatic and non-automatic brakes. Two brake cylinders transmit the braking force through a rod to the brake blocks on the bogie ; there are two brake blocks on each wheel. The hand brake can be operated from either cab and acts on both bogies.

After running some trials in Switzerland, the locomotive had certain parts removed in order to bring it within the Italian loading gauge and was then taken to Genoa, running on its own wheels. For the transport by sea from Genoa to Dairen, it was only necessary to detach the bogies from the frame.

The locomotive has been in regular service since 1931.

Royal State Railways of Siam

The Royal State Railways of Siam ordered from Sulzer Brothers six Diesel-electric locomotives, each of 450 b.h.p., and the trials of the first locomotive were run from July 6 to 20, 1931, in Switzerland, on the Landquart-Chur-Disentis line of the Rhaetic Railways.

In all, the locomotive made eleven return trips and ran a total of 763 miles, not counting the distance covered when shunting. The trials passed off without the slightest hitch, and the results were highly satisfactory to the purchasers and the builders of the locomotive. The total service done amounted to 94,350 ton-miles, in which figure the weight of the locomotive itself is included. During the trials, from the time the engine was first set to work until the tests were finished, a total of 3,410 lb. of fuel was consumed, including the amount used when shunting. The specific fuel consumption was therefore about 0.035 lb. per ton-mile ; considering the steep gradient of the line and the numerous curves, this must be considered as very favorable. The cooling-water temperature never rose above 154 deg. Fah., although the cooler fans ran at a reduced speed during the whole trials.

The manœuvring and shunting operations were carried out with ease and smoothness, and acceleration tests were also made, the train being stopped several times on a gradient of 1 in 37 and again started. The time required for acceleration from stop to 19 miles per hour was then 30 to 35 seconds. It should also be noted that the line on which these trials were carried out has several successive curves of six chains radius, which considerably increased the resistance.

The locomotives are intended for working through traffic on the Siamese main lines, which are 1-meter gauge. They have been built to Sulzer Brothers' design, the electrical equipment being supplied by the Ateliers de Construction Oerlikon, and the mechanical parts by Henschel und Sohn A.-G., Cassel, Germany.

The principal particulars are as follows :—

Gauge	1 m. (3-ft. 3⅜-in.)
Length over buffers	13.59 m. (44-ft. 6¾-in.)
Distance between bogie pivots	7.4 m. (24-ft. 3-in.)
Wheelbase of bogies	3 m. (9-ft. 10-in.)
Number of traction motors	4
Number of driving axles	4
Number of carrying axles	2
Service weight (about)	60 tons
Minimum adhesion weight (about)	43 tons
Diameter of driving wheels	914 mm. (36-in.)
Diameter of free wheels	762 mm. (30-in.)
Sulzer Diesel engine, fourstroke cycle	8 cylinders
Output (continuous) of the Diesel engine at	
700 revs. per min.	450 b.h.p.
620 revs. per min.	400 b.h.p.
530 revs. per min.	340 b.h.p.
Maximum speed	60 km. (37½ miles) p.h.
Tractive effort—one hour rating—at 20.5 km. (12.8 miles) p.h.	4,150 kg. (9,130 lb.)
Maximum starting tractive effort	9,400 kg. (20,680 lb.)

The cooling-water for the Diesel engine is circulated through coolers fitted on both sides of the locomotive. Two fans driven by electric motors draw the air, which enters the side walls, through the coolers and then expel it through openings in the roof. By means of field tappings the speed of the fans, and consequently the cooling effect, can be varied.

The coolers for the lubricating oil are integral with the water coolers.

The generator is self-ventilated, a fan mounted on its shaft drawing air through the active parts.

The locomotive is provided with a vacuum brake and a hand brake. Compressed-air sanders for all driving wheels and for both directions of running, are fitted on the bogies.

The body of the locomotive consists of a steel framework covered with sheet metal, and the roof over the engine compartment is removable, in order to facilitate overhaul of the Diesel-electric set.

Tanks for fuel and water, and the silencer, are arranged in the roof, where the regulating resistances are also situated, the latter being protected by a removable sheet-metal cover. Partitions between engine and cabs are of strengthened sheet metal, as are also the doors. The floor of the engine compartment on both sides of the Diesel engine is double ; the lower floor is of sheet iron and the upper one, the actual floor, is of teak. The space between them is used for the cables and piping. The frame of the locomotive is formed of rolled sectional members. The draw bar and buffer gear is fitted on the bogies, which support the main frame on spherical pivot and substantial side bearings.

Diesel-Electric Rail Cars

The adoption of rail cars in railway service is a question of general interest at the present moment. The effect of the competition from motor-cars, to which must be added the general depression caused by the present crisis, induces railway companies to improve their means of communication in less frequented districts, whilst at the same time avoiding any increase in expenses.

The two reasons which have just been mentioned might possibly lead one to think that it is only comparatively recently that the necessity for rail cars has been felt. But when the conditions are considered in which a small railway company that is not favored by dense traffic is placed, it will be easily understood that such a company was already obliged before the years of the crisis to obtain as much benefit as possible from local transport. Increasing the number of trains and especially of local trains, replacing mixed trains by separate trains for passengers and goods traffic, improving communications with neighboring railway systems, introducing late trains in the evening—all these means could be adopted to increase passenger traffic. A corresponding increase in expenditure could certainly not be avoided if the method of traction was not at the same time altered. Adopting the Diesel-electric rail car, which had already been developed before 1914, would be the appropriate solution.

1.—The low consumption of fuel which can be purchased at a moderate price, and the fact that no fuel is consumed during stops, driving the car by one man—these are advantages which allow economies to be realized exceeding the extra expenses caused by increasing the number of trains.

2.—The rail car is constructed as a normal railway carriage and is fitted with an engine powerful enough to allow of trains being built up from existing rolling stock ; in case a large number of passengers have to be conveyed, the composition of the train can be adapted to cope with this without any increase in staff. Even when steam traction is retained along with Diesel traction, for example for goods service, the rolling stock is all standard. This is not the case for motor coaches adapted to run on rails, which are special machines and cannot be coupled to existing rolling stock.

The advantage of adopting the rail car is, however, not limited to small companies, since most of the large railway systems also have certain lines of purely local interest, or can utilize rail cars on purely non-electrified main lines in order to improve the means of communication between intermediate stations and those served by express trains.

Rail Cars of the South Manchuria Railway

The South Manchuria Railway Co., Dairen, put two 50 b.h.p. Diesel rail cars in service at the beginning of 1932 ; these vehicles were ordered later than the 750 b.h.p. Diesel shunting locomotive, which is also described here. The principal frame and the body of these cars were built in the railway company's own workshops, whilst the Diesel-electric equipment and the bogies were supplied by Sulzer Brothers.

The principal characteristics of the rail cars are as follows (see also wiring diagram, fig. 18) :—

Gauge	1,435 mm. (4-ft. 8½-in.)
Length between buffers	17,756 mm. (58-ft. 3-in.)
Distance between bogie pivots	11,100 mm. (36-ft. 6-in.)
Wheel base of bogies	2,500 mm. (8-ft. 2-in.)
Number of axles	4
Number of driving axles	2
Diameter of the wheels	1,040 mm. (3-ft. 5-in.)
Weight of rail car in running order	48.3 tons
Diesel engine output, continuous rating	
at 775 revs. per min.	250 h.p.
at 650 revs. per min.	210 h.p.
at 525 revs. per min.	170 h.p.
Maximum speed of rail car	65 km. (40 miles) p.h.
Maximum tractive effort at the rail	4,000 kg. (8,800 lb.)
Tractive effort at 25 km. (15 miles) per	
hour,	2,000 kg. (4,400 lb.)
one hour rating	1,300 kg. (2,860 lb.)
Tractive effort, continuous, at 30 km.	
(19 miles) per hour	
Radius of sharpest curve	70 m. (3½ chains)

The four-cycle Diesel engine has six cylinders and is of the usual type employed in traction. The water coolers are fitted on the roof of the car; they are composed of gilled tubes placed transversely. As soon as the circulating pump is stopped, the coolers empty automatically, thus preventing any risk of freezing.

The lubricating oil is cooled in the crank-case below the engine, the lower part being exposed to the current of air produced when the car is running.

The electric equipment and accessories are similar to those in the cars previously supplied.

The rail car has seating accommodation for 65 third class passengers in one compartment. There is also a compartment for the machinery, and two cabs for the driver. The body of the car is built on a frame of rolled-iron sections, and covered internally and externally with wood. The battery of accumulators is located in boxes placed under the principal frame between the bogies. Except for the traction motors, all parts of the electric equipment and apparatus are placed in the machinery compartment or the driver's cabs. The roof above the engine-room may be removed along with the coolers contained in it, in order to allow the Diesel generator set to be hoisted complete out of the car. The suspension of the bogies is very carefully designed. The axle bogies, provided with ordinary bearings with oil pads, are fixed to the frame of the bogie through helical springs.

The two rail cars described here are in regular service in Dairen and district.

Pig-iron Combine in Japan

According to a report from Yokohama, the Commercial and Industrial Minister of Japan recently asked the Director of the Imperial Works at Yawata to get and sumbit to him figures of the output of pig-iron and its cost of production at each of the various blast-furnace plants in Japan. Proposals have been made to amalgamate the six pig-iron producers, but a difference in their interests is thought to make that very hard of realization. According to an official investigation, the cost of production in Japan is Y.53 (£3 10s. 8d.) for steel ingots, and Y.40 (£2 13s. 4d.) for pig-iron per ton. The Minister is afraid that by buying up the iron and steel works such an enormous amount of capital would be locked up as to make the business unprofitable, and cause too for a rise in the prices in consequence, that would only aggravate the situation. He seems to be, however, inclined to have the leading pig-iron works bought up by the Yawata works, if possible, but at the moment to be doubtful about finding the necessary funds.—*Foundry Trade Journal.*

The Royal State Railways of Siam

Working and Results

By B. REED, in "Eastern Engineering and Commerce"

RAILWAY construction in Siam commenced in 1891 with a private line, 12½ miles long, from Bangkok to Paknam, which was opened in 1893. Work on the first Government line started in 1892, but the contractor making slow progress, the State took over the construction in 1896, and completed the 165 miles from Bangkok to Korat in 1900.

The north route to Chiengmai leaves the Korat line at Bang Phaji Junction, and was opened to Lopburi, 27 miles, in 1900. Both of these lines were laid to the standard gauge, but when, in 1899, the southern line towards the Malay Peninsula was mooted, the gauge question arose, for this line would eventually be linked up with the meter-gauge Malayan and Burmese systems. It was decided to make all the lines west of Bangkok to the meter gauge, and keep to 4-ft. 8½-in. for the northern and eastern areas, but in 1919 conversion to a uniform gauge was sanctioned, and by April, 1930, all lines were of meter gauge.

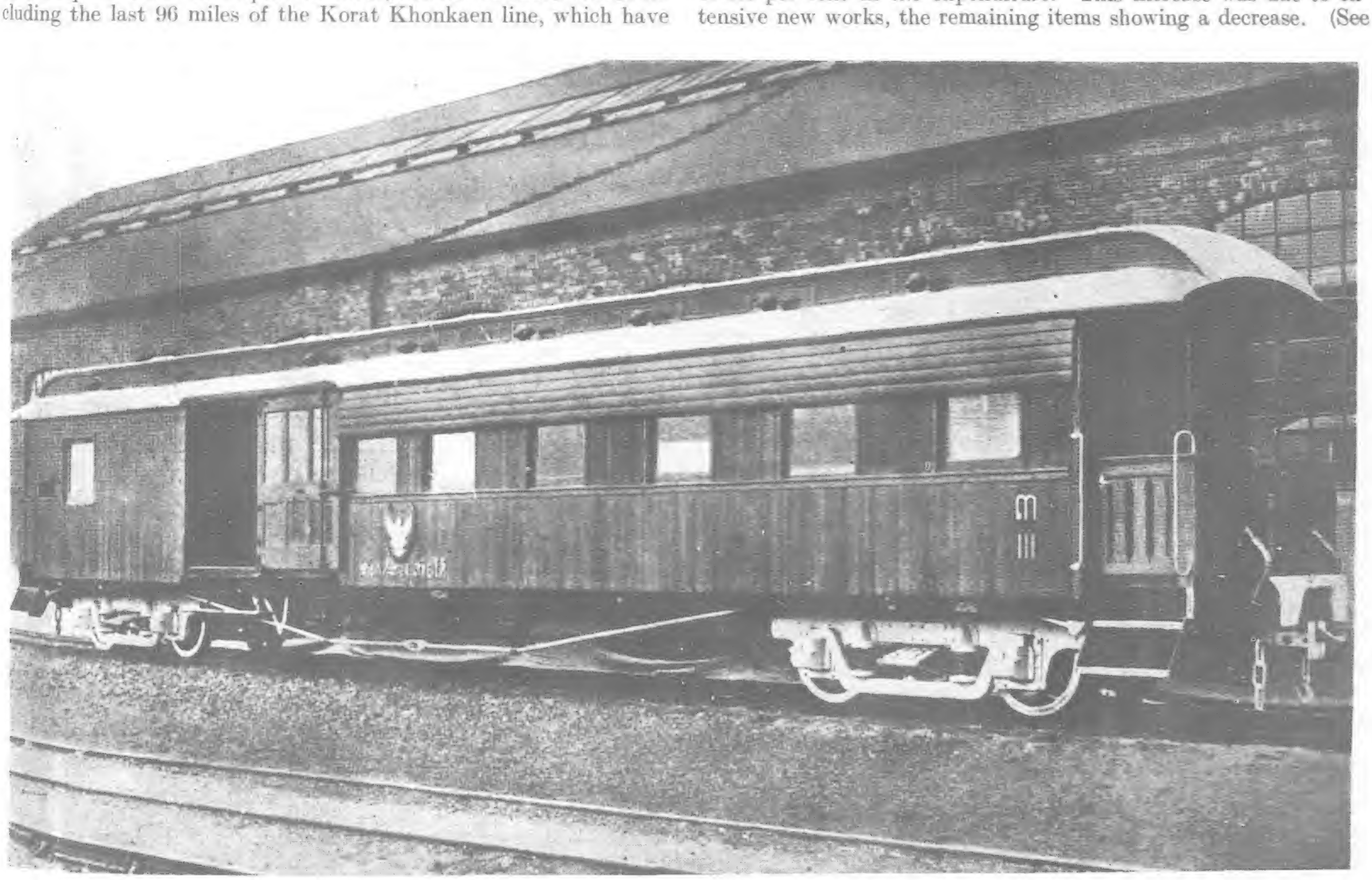
In 1903 the southern line was opened over the 95 miles from Bangkok to Petchaburi, and, proceeding by stages, the frontier at Padang Besar was reached in 1919. The northern line had been pushed on to Pitsanuloke in 1907, and traffic through to Chiengmai was started on January 1, 1922. The Aranya Pradesa line was commenced in 1908, but only reached the Indo-China border five years ago. Other recent extensions are the 195 mile Ubol branch from Korat, and the Korat-Khonkaen line, which has just been opened.

At the present time the State lines comprise 1,908 route miles, with a further 250 miles under construction or survey. The capital invested in these lines and their equipment is baht 185,948,201 (approximately £16,900,000 at par ; 11 gold baht to the £), or baht 102,600 per mile of line open to traffic, neither of these values including the last 96 miles of the Korat Khonkaen line, which have been completed since the compilation of the last annual report. Of the total capital, the sum of baht 1,548,144 was spent in conversion of the line to meter gauge. The equipment includes 410 stations, 171 steam locomotives, 15 Diesel locomotives, six Diesel-electric railcars, 307 passenger carriages, 3,213 goods wagons, a handful of motor-tramcars, and a large works at Makasan, near Bangkok.

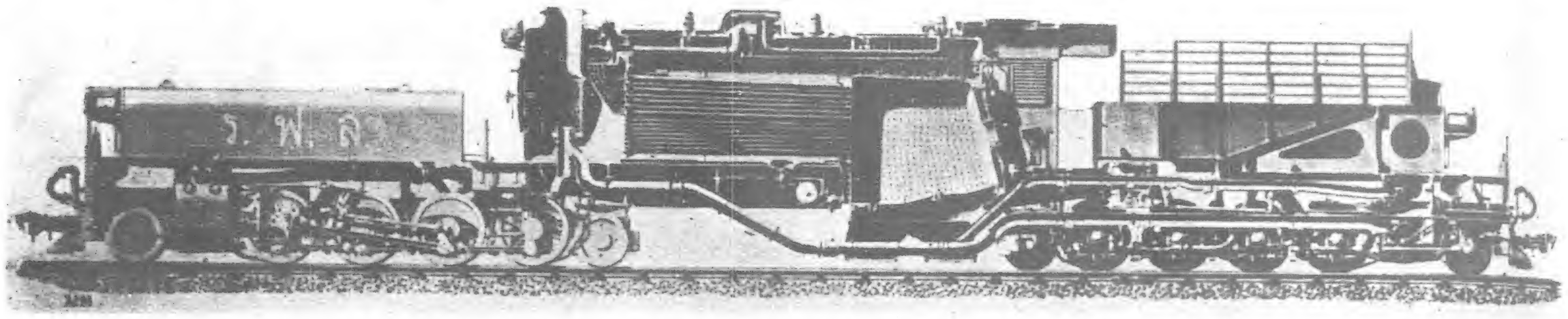
Prior to the change-over to a Constitutional Monarchy, the railways came under the Ministry of Agriculture and Commerce, but they are now administrated by a Board of Railway Commissioners, whose thirteen members include, *ex officio*, the Minister of Agriculture and Commerce and the Commissioner-General of Railways. Neither the extent nor disposition of the system warrant decentralization, and everything is directly controlled from the headquarters at Bangkok.

Although traffic has slumped heavily within the last three years, due to the general depression, the last annual report issued, for the Buddhist Era 2473 (1930-31), shows a substantial net profit after meeting all charges. But, unlike the Japanese Government Railways, the Railway Budget is not independent of the State finances, and contributions are made to the Treasury from the profits. For the year under consideration the net profit was baht 6,521,979, representing a return of 3.5 per cent on the invested capital. On operating alone the profit amounted to baht 7,451,722, the operating ratio being only 54 per cent. The capital and operating figures for the last two years available are given in Table I, while details of the expenditure are included in Table II.

Compared with the previous year, the large reduction of 16.22 per cent in the gross receipts of 1930-31 was enhanced by an increase of 6.5 per cent in the expenditure. This increase was due to extensive new works, the remaining items showing a decrease. (See



Royal Siamese State Railways: Third Class and Brake Corridor Carriage



Royal Siamese State Railways: A "Double Mikado" Garratt Locomotive

Table II.) By converting 21 engines from standard to meter gauge, and fitting superheaters and Caprotti valve gear to six 4-6-0 locomotives, the efficiency of the locomotive power was kept up with relatively little expense, while due to the reduced fuel consumption and mileage, the rolling stock and maintenance expenses were reduced by 4 per cent.

TABLE I.

		1930-31	*1929-30*
Capital	Baht.	185,948,581	182,057,614
Capital per km. of open line	,,	63,637	63,536
Working Revenue	,,	16,182,726	19,330,124
,, Expenses	,,	8,731,004	8,203,928
Operating Expenses to Receipts	Per cent.	53.95	42.44
Profit on Operating	Baht.	7,451,722	11,126,196
Renovation and Reserve Funds	,,	929,743	910,288
Net profit	,,	6,521,979	10,215,908
Receipts per km. of open line	,,	5,538	6,761

TABLE II

		1930-31	*1929-30*
Salaries, Wages, etc.	Baht.	2,320,145	2,350,868
General Charges	,,	379,490	456,661
Maintenance of Way, Buildings	,,	1,959,532	1,983,679
Loco and Rolling Stock	,,	2,379,319	2,478,031
New Works	,,	1,692,518	934,689
		8,731,004	8,203,928

Wood is the fuel used for all the steam locomotives, the total consumption for the year being 495,573 cubic meters, or approximately 350,000 tons; that is, 6.7 cubic meters per 100 engine kilometers, against 7.2 cubic meters in the previous year. The engine kilometers dropped by 4.14 per cent to 7,684,680, and the train kilometers by 4.28 per cent. (See Table III.) Part of the reduction in engine kilometers was due to the introduction of six Garratt engines built by Henschel, which are now working on the Gengoi-Korat line, on the Pass section of which they have increased the traffic capacity by 50 per cent.

Goods tonnage decreased by 9.9 per cent, and the goods receipts by 16.42 per cent, but the decrease in the live stock traffic was greater still, only 280,501 head being carried, against 355,476 in the previous year. Pigs form by far the greatest proportion of the live stock, 93 per cent of the total being represented by this trade. Total goods and live stock receipts amounted to 55.2 per cent of the gross earnings.

The decline in passenger traffic was just as serious, the number of people carried decreasing by 19 per cent, although the average journey increased slightly, the receipts falling by 16.5 per cent. Following on the introduction of six Frichs Diesel-electric railcars, the fares on the suburban lines around Bangkok have been reduced, and further

Map of Royal Siamese State Railways

- - - - - - - - - - - - - - Lines Open to Traffic

. . . . . Lines Under Construction

economies are being realized on the southern main line by using 1,000 horse-power Diesel locomotives on the Singapore expresses. The Malayan slump in tin and rubber has had its effect on the Siamese Railway earnings, and both passenger and goods traffic on the southern line have been disappointing. Traffic figures from the whole system for the last two years available are given in Table III.

TABLE III

		1930-31	*1929-30*
Number of passengers carried		5,284,637	6,303,410
Passenger earnings	Baht.	6,668,552	7,763,825
Total coaching receipts	,,	6,896,703	8,026,923
Average passenger journey	Km.	50.46	49.12
Volume of goods handled	Metric Tons	1,281,853	1,422,681
Head of live stock handled		280,501	355,476
Total goods and live stock earnings	Baht.	8,940,262	10,859,507
Total train kilometrage	Km.	6,066,002	6,337,748
Running cost per train-kilometer	Baht.	1.44	1.29

Although it was found necessary to increase the number of employees from 16,481 to 16,866, in view of the increased mileage open to traffic, the wage and salaries bill was reduced by $1\frac{1}{4}$ per cent. The staff includes only 19 Europeans, the Siamese numbering 15,330, the Chinese 1,204, the Indians 140, and others 173. Severe retrenchment has been in progress during the last eighteen months.

Accelerations have been effected on both north and south main lines, and the Diesel locomotives are showing to advantage on the express services. The running time from Bangkok to Padang Besar has been reduced from 26 to 22 hours, while on this special service one Diesel locomotive is replacing four steam engines. Owing to the light construction of all the lines, the maximum permissible speed is only 40.5 m.p.h. (65 km.p.h.), but as there is little demand for fast schedules this is not a great disadvantage. The Singapore expresses load up to 14 bogie cars weighing 420 tons, otherwise the passenger trains are light.

The bulk of the passenger traffic is looked after by 61 "Pacific" locomotives, all except four being three-cylinder engines. There are only 11 tank locomotives in service, all of the 0-6-0 type, the steam-worked local traffic being hauled by 4-6-0 tender engines, and ordinary goods traffic by 2-8-2 machines. The locomotive stock is somewhat heterogenous, and hails from Britain, France, Germany, Switzerland, Denmark, and the U.S.A. There are two 0-10-0 locomotives in service, which were recently converted from the standard to the meter gauge. Although constructed twenty years ago, they are fitted with Lentz poppet valves, and are able to handle 1,500 ton goods trains at 20 m.p.h. on the level. Their size was restricted by the maximum axle load, $10\frac{1}{2}$ metric tons, permitted to any steam

(Continued on page 424)

Diesel Railway Traction*

An interesting address was given at a meeting of the Oil Industries Club by Mr. C. J. Hyde Trutch on the development and outlook for the diesel engine locomotive unit in regard to railway traction.

In the course of his remarks Mr. Trutch said :

Experiments in the application of the internal combustion oil engine to railway purposes have been going on almost from the invention of the diesel engine. It is only during the post-war years that the experience with the diesel engine at sea and in stationary plants, combined with the technique and materials developed in the fields of aircraft and automobile, have produced designs suitable to railway requirements.

Railway requirements, as known to British engineers, involve the reliability and low maintenance over a long life of the marine engine, combined with as much as is possible of the lightness of the aircraft or automobile type, and such features of these latter types as ensure automatic operation without the necessity for an attendant in the engine room. Light weight can be secured by running at high speed, but a required life of, say, 25 to 30 years, limits speed at present to from 650-1,000 r.p.m. according to size.

Weight is also reduced by the use of steel castings and fabricated steel for main structure and by using light alloys and alloy steels for moving parts. Automatic oil and water circulation and complete enclosure is taken from automobile practice. Railway working entails the utmost simplicity, consequently airless injection of fuel is used and four-stroke designs are favored, as thereby scavenge pumps and the cooling of pistons and valves are avoided. Simplicity is of greater importance than the last decimal point of efficiency. The engine must be self-supporting, that is to say, it must not rely upon the locomotive or coach frame to provide a rigid foundation.

The weight of a successful engine built on these principles is 28-30 lbs. per b.h.p., its rated B.M.E.P. being 75-80 lbs. per square inch. It has a cast cylinder block with renewable liners and separate heads, mounted upon a fabricated crankcase designed to give sufficient rigidity without additional foundation. Aluminium alloys are used for pistons and covers.

Engines above 150 b.h.p. are run at fixed speeds, which can be chosen by the driver according to the power required. This obviates the possibility of continued running at even minor critical speeds—a most important requirement to ensure that fatigue does not shorten the life of the engine. The engine is designed for remote operation from a driver's cab at the far end of a train with no attendant in the engine room. Oil and water safety devices are fitted. On the Continent of Europe high-powered light-weight engines running at higher speeds and approximately more nearly to aircraft engine practice are being used in light-weight vehicles of equally short-lived construction. I refer to the Flying Hamburger and rubber-tyred types. It seems improbable that these types will be accepted to any extent by British railway engineers and it is yet to be discovered how they will stand up to railway conditions after a few years. Attempts to use lighter types have been made in this country and several engines of the same type were sent overseas, but they have given considerable trouble and have tended to retard progress by their unduly high maintenance costs. There is some indication that the conservative British railway standards of long life may be modified in respect to light single vehicles of the so-called rail-bus type, which can be equipped with suitable quantity-produced commercial vehicle type engines of powers not exceeding 150 b.h.p. These vehicles appear to have a large field on branch and local lines as feeders to long distance trains in competition with the road bus. The low first cost and necessity for very light weight of this type of vehicle may justify the rapid depreciation. There are now a number of engines of this type on the market and one or two are giving very satisfactory results in road service. They can be safely applied to light rail vehicles provided they are protected by a suitable flexible transmission.,

Much is heard about electric versus mechanical transmission between the diesel engine and the vehicle wheels. Briefly the mechanical gear-box, with suitable power operated clutch, or hydraulic coupling, can be used for low-power vehicles. It is technically unsuitable for high powers and all experience leads to the adoption of electrical transmission for engines above, say, 200 h.p. and even down to 100 h.p. electric transmission of suitable design and simplicity is economically justified in spite of slightly higher first cost and is technically superior. The mechanical gear-box necessitates a variable speed engine, and its safe adoption is therefore limited to low powers, where the engine can be loaded throughout a wide range of speed without fear from critical speeds. For this reason it cannot be used for high powers without such complication as to be uneconomic compared with electric transmission. In large sizes the gear-box becomes so difficult to manipulate as to lose any advantage it might have. It is stated that there are only five men in Russia who are able to drive the big-geared Russian locomotive designed by Professor Lomonossoff. The diesel engine, being a constant torque machine, its h.p. output varies directly with its speed. It follows, therefore, that if a four-speed gear-box is employed there are only four speeds at which the full h.p. of the engine can be employed. This means that the value of the high efficiency of a direct or geared drive is lost when a heavy train has to be worked over a normally graded line, and it is found that electric transmission, with its much lower efficiency, can actually cover a given route faster Electric transmission has at least double the life of a well designed gear-box, even when the gear-box is protected by an hydraulic coupling. The life of electric transmission in actual railway service is proved to be at least 30 years. The life of a gear-box in public service road vehicle work is often less than 30 weeks. The flexibility of electric transmission enables the engine to work under the most favorable conditions and so increases its life and reduces its maintenance. It enables a completely automatic and fool-proof control to be obtained with the minimum number of parts and utmost simplicity. In the smaller sizes electric transmission involves no more electrical equipment than is required when electric starting is employed with a mechanical drive and it can readily be maintained by existing railway running shed staff or by any competent garage staff. The electrical transmission to which I refer is not merely a conglomeration of standard electrical machines and control gear bought over the counter from an electrical manufacturer. It is a severely proved, smplified and lightened assembly designed by and for the locomotive and engine builders with knowledge of the ruggedness and simplicity essential in any railway power unit. To make a really successful economic unit, engine, locomotive and transmission must be designed under one roof. Electric transmission in general gives to diesel railway traction practically all the advantages of electric traction, and while a perfected hydraulic transmission might replace electric on certain types of self-contained locomotives, the diesel electric principle has great advantages in the case of certain kinds of train working, as for example the multiple-unit motor-coach type employed on the Southern Railway electrified lines.

There are four fairly distinct types of diesel electric unit employed for railway working :—

(1) The self-contained locomotive, which is in effect an electric locomotive carrying its own power generating equipment. This can be designed to do anything that a steam locomotive will do and will haul ordinary main-line carriages or goods wagons and will do shunting. It has several distinctive advantages over the steam locomotive, other than its low fuel cost. Unlike steam, which necessitates two distinct types for goods and passenger working, the diesel electric locomotive can be economically designed to do both classes of work and so makes for standardization and its attendant economies.

The large 1,700 b.h.p. main-line locomotive recently shipped to the Argentine for the Buenos Ayres Great Southern Railway is to be used for passenger services running up to 75 miles an hour, when it is not required in the harvest season for hauling heavy freight trains.

Further, two diesel electric locomotives can be coupled together and driven by one crew in so-called multiple-unit. This means that one diesel electric type replaces four distinct steam types with consequent reduction in spares required and in shed and shop expenses.

**Eastern Engineering and Commerce.*

The diesel electric locomotive needs no turn-table. It does not require frequent stops for fuel, water and boiler and firebox attention. It can readily be quipped to run 1,000 miles without fuel, water or attention. What this means in the cost of building and maintaining a long line overseas, particularly where water is bad and fuel must be hauled long distances, can be readily realized.

In one case of a projected line 700 miles long, 27 steam locomotives of three different types will be replaced by 11 diesel electric locomotives of one type and six intermediate running sheds, and their equipment will be eliminated.

(2) The mobile power house. This, as its name implies, is a diesel generating plant on wheels designed for attachment to an electric train having motors on the carriage bogies, such as the trains used on the Southern Railway. This type enables the train to be driven from either end by one man and to run backwards without detaching the power unit, thus saving time and terminal accommodation. It also enables higher acceleration to be obtained than is possible with a locomotive. This type is being used for suburban services on the Buenos Ayres Great Southern Railway and would be used for the bulk of the stopping passenger trains outside the dense suburban areas in this country.

(3) The heavy rail motor coach. This is a carriage having a diesel-generating set in a small compartment at one end, which supplies power to motors on the bogies. For example, the "Tyneside Venturer" and the Armstrong-Shell Express. This type normally pushes or pulls one or two ordinary carriages, the train being driven from either end by one man. It is cheap to run, light and speedy, and is used for branch line and light local services. To increase accommodation two such unit trains can be coupled together and driven by one man at the same speeds.

(4) The light rail-car or rail-bus. This is a lightly constructed unit of low first cost designed to provide fast, frequent services of single vehicles to compete with road services where traffic is light.

As these vehicles are not designed to run in trains, they can be designed differently from orthodox railway rolling stock. Construction follows conservatively road-bus principles where applicable and streamlining may be employed to reduce power requirements.

Much has been heard about pneumatic-tyred vehicles of this type. In practice these involve an extremely light and consequently expensive vehicle construction, as the tyre can only carry about ½ ton on an ordinary rail. While the tyre cushions vibration, it cannot prevent the wracking strains to which a high-speed vehicle is subject and the vehicle must of necessity have a very short life. Experience here showed that the tyres were apt to get out on points and crossings. As light weight is essential to keep down the number of wheels, engines of the ultra light-weight types must be employed, with consequent short life and high cost of maintenance. It seems probable that the steel tyre will be retained.

Developments

The light rail-bus and heavy rail motor-coach types have been extensively used abroad for some years. They are very rapidly multiplying and will no doubt be used on a considerable scale in the United Kingdon in the near future. In North America there are between 800 and 1,000 of the heavy type in operation, mainly using distillate burning engines. Compression ignition engines are, however, being rapidly adopted and powers vary from 300 to 900 b.h.p.

In Germany considerable numbers have been in operation for several years, and 45 of the latest types, varying from 175 to 400 b.h.p., are now on order for the State Railways.

In Denmark diesel coaches have practically replaced steam on a great many of the branch lines.

In Holland orders have been placed for 40 three-coach articulated motor-coach sets of 400 b.h.p.

In France light units of the rail-bus type have been runming for some years and from 20 to 30 vehicles of various types are on order.

In Great Britain the L.N.E.R. have run the "Tyneside Venture" for a year, covering 50,000 miles without involuntary stop. The L.M.S. have run the Armstrong Shell Express and have placed a small order for a light rail-bus type. Trials are being carried out on the L.N.E.R. at Newcastle with a light streamlined rail-bus.

So far as heavy mobile power house trains are concerned, the Buenos Ayres Great Southern Railway have been operating two 1,200 b.h.p. suburban trains, seating 600 passengers, with great success for nearly three years. As a result three more units of 1,700 b.h.p. for trains seating 1,000 passengers have now been put into service and it is likely that the whole of the Buenos Ayres suburban traffic of this line will be handled in this manner in the near future.

It is also likely that this type of diesel electric train will be adopted on a considerable scale in Great Britain in the near future. Analyses of working costs show that in a great many of our inter-urban and provincial local services the first cost of these units can be repaid in from four to five years by the savings over steam working.

The locomotive type of unit has been extensively used for shunting for some years and between 200 and 300 locomotives between 300 and 900 b.h.p. are in service in North America. Large numbers of light shunting locomotives for wayside station and industrial use are being employed on the Continent of Europe and their use is extending.

The heavy main line locomotive is naturally the last type to be adopted because for long distance main line working the steam locomotive works to its best efficiency. Nevertheless, the Danish State Railways, after experience with several locomotives, have decided to build no more steam locos.

The Bangkok-Singapore mail is regularly worked over the Siamese section, 620 miles in 22 hours, by diesel electric locomotives with very substantial economy and saving 4½ hours on the journey, and the Bangkok local services are similarly handled.

The Russian Government are equipping their Southern lines with heavy locomotives and several are in service.

A heavy trial locmotive equal to the most powerful steam loco has recently been put to work in the Argentine and has run perfectly at 75 miles an hour.

Our electrical friends would have us believe that now the Central Electricity Board's "grid" is in being, great savings and advantages are to be obtained by electrifying the main lines of this country. They have, however, failed to produce any convincing figures in support of their contention and the Weir Report showed conclusively that only a bare margin was obtainable over the cost of financing.

On the other hand, it has been shown that substantial returns in the region of 15 to 20 per cent are obtainable with the adoption of diesel traction.

It will interest the many to know that in economic comparisons between steam, electric and diesel working, the saving in fuel cost is not the major item. Compared with steam greater sums are saved in other operating expenses such as labor and maintenance and the ability to remain in service for long periods without attention, thus reducing shed accommodation, turntables and intermediate sheds are all eliminated. Compared with electric, capital charges are greatly reduced unless traffic density is very high.

It would appear that track electrification must now be limited to dense urban and suburban districts and on the bulk of the main and subsidiary lines the steam engine will inevitably be replaced in the fulness of time by diesel.

Japanese Film Factory

Hopes of developing export trade in raw stock for moving-pictures with Japan may be affected by the decision of a Japanese celluloid company to build a factory at a cost of Y.200,000 for the home manufacture of film stock.

Japan is a very large consumer of motion picture stock. Until a few years ago more than half her requirements were supplied by American firms. Then a British manufacturer obtained a footing in the market. When Japan left the gold standard, the price of the American film became almost prohibitive, and British manufacturers hoped to secure a much firmer footing in the Japanese market.

It is understood, however, that the new Japanese factory is likely at first to concentrate on the manufacture of positive film stock, which will leave the market open at present for the supply of the much more costly negative stock from Britian.

The Japanese Government plans to grant the new company a subsidy of Y.1,200,000 (£120,000 at par).—*Reuter.*

Notable Year of Progress Recorded in Working of The Hongkong Telephone Company

By J. P. SHERRY, Manager, The Hongkong Telephone Co., Ltd.

Showing Hongkong Telephone Company's exhibit at the recent British Empire Fair held in Hongkong

PRIOR to 1925 the Hongkong Telephone Company, as such, was non-existent. The system in Hongkong was operated through the Oriental Telephone & Electric Co., from London. In 1925 however, the Colonial Government gave a franchise to the Hongkong Telephone Company, on condition that within a fixed period they would convert the entire system then operating to the most modern type, and furthermore that all overhead distribution, within city limits, be replaced by underground cables.

The last mentioned work was tackled in a determined fashion in 1925, and by 1928 approximately 80 per cent of the circuits were served by direct underground connections. This work was carried out without any additions to the normal staff.

In 1930 the whole system was changed to direct automatic working. This cut-over, one of the most difficult of its kind, being a change over from C.B.S. system to full automatic working, and done without any addition to the normal staff, was successfully accomplished. In most cut-overs of this kind the complications attendant upon the cables, circuits, and exchange sections of the change overs are usually dealt with by experts specially imported for the job. In the case of the Government Post Office at home, men are provided from all over the country to assist in the change over. The new system is a complete success and has received enthusiastic reports from the Press.

From 1925 onwards the Company has experienced rapid progress, the present number of telephones operating in Hongkong being close upon sixteen thousand.

In other directions of telephone development the Company has not been slow. In 1931 teleprinters were introduced into the Colony, and have operated successfully since that date. Also in 1931 the Company established trunk communication between Hongkong and Canton. This cable sufficient to carry 30 conversations was the first of its kind to be introduced into South China. The engineering difficulties in the way of laying this cable were enormous, but with indefatigable energy they were tackled by those deputed to the work, with the result that the cable was connected up some time ahead of schedule. This cable has since operated successfully, and has proved a boon to business men in South China. Coincident with the introduction of the trunk cable a system of picture transmission was introduced for demonstration purposes and worked perfectly.

The Company has also introduced various developments to the Colony within recent years, in the shape of the most modern type of rural automatic exchange work. This is operating satisfactorily in what is known as the New Territories, and has supplied a greatly needed want in these areas.

All these modern innovations have been introduced in a climate which is forever striving to undo the work of engineers. Throughout the whole of the summer months the humidity is such that, books, radio sets, pictures and clothes have to be specially stored in drying rooms, in order to prevent them growing fungus and rotting during humid periods. Telephone apparatus however, is required to stand up not only to the bad weather and an abnormally heavy calling rate, but to give a high grade of service. This requires a standard higher than that required elsewhere.

The charge for telephone service, approximately £9 a year for an unlimited service, is as low as can be found anywhere in the world.

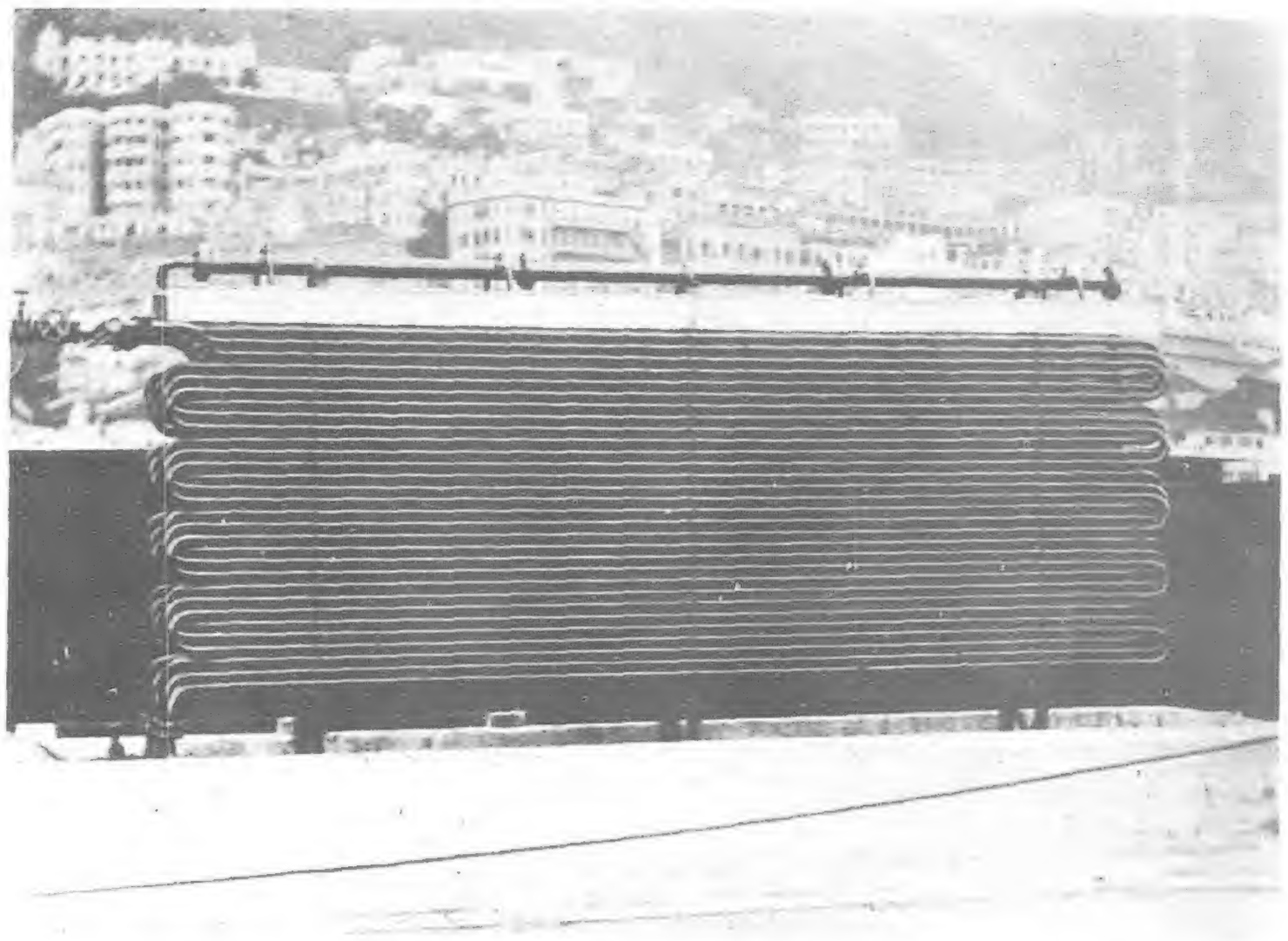
Hongkong Telephone Company's Kowloon Exchange Building

Workmen engaged in handling one of the largest Submarine Telephone Cables Installed in the Far East

At the recent British Empire Fair held in Hongkong the Telephone Company installed a complete public address system for the purpose of the exhibition. The Company's own exhibit was given the place of honour, and due to its attractiveness drew tremendous crowds. Demonstrations were given on a large working model of a step by step automatic exchange, on teleprinter working and also on a special innovation of the Company's, the "Loud speaking telephone." This being a special 'phone designed for busy men, and is far in advance of any other type yet designed. The Company is shortly putting this into production. Public address systems have since been fitted in hotels and churches in the Colony with marked success.

Despite these achievements the Hongkong Telephone Company is forever striving to do more and, at the present time telephone manufacturers from all over the world realize this and send samples of their products to the Company for testing under the difficult humid conditions prevalent in the Colony.

* * *



Condenser in Air Drying Plant of the Hongkong Telephone Company

Supplementing the foregoing additional details of interest regarding the activities of the Hongkong Telephone Company were given in an address recently by Mr. C. Gordon Mackie, Chairman of the Company, on the occasion of the Company's Annual General Meeting on March 22 last. Pertinent portions of this address were as follows: "Speaking from the Chair at the last Annual Meeting, I pointed out the rapid progress which the Company was making and indicated that your Board were then considering a proposal to extend the Automatic Exchange Equipments both in Hongkong and Kowloon, and you will be pleased to learn, therefore, that an order has been placed with Siemens Bros. of Woolwich, London, for an additional 4,000 lines of switching equipment for Central Exchange, and 2,500 lines for Kowloon and that the actual work of installation is now in progress. This represents an increase of approximately 50 per cent in Exchange capacity and is in keeping with the progressive policy of your Company in putting down in advance ample equipment embracing all modern improvements whereby it is enabled to give an efficient telephone service and to supply such service on demand.

The whole of the equipment will be manufactured at Woolwich and favorable terms were obtained on this order.

In July, 1932, two small Automatic exchanges were installed at Taipo Market and Fanling and are affording a first class service to those subscribers who are connected thereto. The data obtained from the operation of these Exchanges will be very useful to the management in determining what demand exists for telephone service in rural areas and whether progress is such as to justify the opening of further similar Exchanges from time to time in other districts.

In the matter of radiotelephone communication with far distant points such as Shanghai, we have kept in touch with Imperial and International Communications Ltd. and a recent letter to hand advises that negotiations are still proceeding with Government and that radio communication should be established in about one year from the completion of such negotiations.

In connection with the Canton Trunk Service, we have been able to observe the results of a full year's working and these, in my opinion, justify the confidence which animated your Directors when they authorized the putting down of the Trunk Cable. This service has been in operation now since September 1, 1931, during which time it has functioned day and night without interruption.

During the year under review, 877 additional Exchange Lines and 264 Extension Lines were connected up and over 5,000 circuit miles of Underground Cable and Covered Distribution were laid down.

In conformity with the desire of your Company to afford subscribers all the advantages of modern progress in matters affecting telephone communication, Teleprinter Service was introduced to the Colony during the year and I have no doubt that in the course of time, when commercial houses realize the immense value of this class of special service in certain businesses, the number of Teleprinter installations will rapidly increase.

Molybdenum Found in Rokko

Molybdenum ores have been found in the Rokko hills near Takarazuka. The deposit is located in the Rokko hills about five miles south of the Sakasegawa station on the Hankyu's Imazu-Takarazuka line. The discoverer is Mr. Jinkuro Wada, of Yoshimotomura, in the suburbs of Takarazuka. He has applied to the Osaka Mining Bureau for permission to prospect in the 1,000,000 tsubo area in the neighborhood.

The molybdenum is a comparatively soft, silver-white metal, the alloy of which is used in manufacturing military supplies, warships, guns, and so on, and it is highly valuable. Japan depends mainly on the foreign supply. During the world war, it was quoted at about Y.9,800 per ton.

"A wood cutter discovered the ore some 40 years ago and he brought it home," Mr. Wada said, explaining what prompted him to go into the woods. "The wood cutter showed the ore to my father, and my father, in turn, asked one of the Hyogo Prefectural Assemblymen to find out what the glittering metal was. Someone said that it was antimony and that its market value was so small that it would not pay even the miners' wage. Discouraged, no one bothered about the ore any more to this day.

"I understand that such ore was found in large quantities when the sand erosion prevention work was carried out in the upper Sakasegawa some 30 years ago."

The story of "glittering metal" had interested Mr. Wada. He had long planned to go into the woods in the upper stream of the Sakasegawa, and he finally did, resulting in the discovery of the ore.

Mr. Wada, however, knew better than to ask what it was of the local people. He took the ore to the Osaka Mineral Analysis Station and also to the Kuwabara Mining Office of Kobe. The experts of these places agreed that the ore was that of molybdenum.

"I don't know, however, how much molybdenum will be stored in Mount Rokko," Mr. Wada declared. "I shall have to explore the locality with dynamite to find it."

Deep Well Waters in the Shanghai Area*

By F. G. C. WALKER, F.I.C., Ph.C.

A PAPER with the above title was prepared for the 1925-1926 Session of the Engineering Society of China and the present paper represents the original one rewritten and enlarged in the light of a more complete collection of data which has since been accumulated.

As previously stated the object of the paper is not to attempt a complete survey and discussion of underground sources of water in Shanghai but to present as a contribution towards such a possible survey a fairly extensive collection of analyses, with some explanatory notes and comments attached, in which the chemical characters of the waters are revealed and which may be of interest and possibly of value to the members of the Engineering Society in connection with the underground sources of water supply in this area.

For this purpose a collection has been made of figures from the analyses of some 160 unduplicated samples of water from deep borings. These analyses are not all complete but in all cases figures are given which sufficiently indicate the general character of the water under examination. These figures are tabulated and are presented in the form of an Appendix (A). Most of the analyses given in the original paper are incorporated in the present one. The analyses do not cover all the known deep wells in Shanghai and some are of waters from borings which were afterwards abandoned but the sites of the borings are fairly well distributed over the Settlement and immediately surrounding areas.

As any value that this paper may have, resides chiefly in the tables of analyses and the accompanying spot map, some explanation and comment on the method of tabulation is desirable at this point.

Table of Analyses *(See Appendix A)*

Arrangement in Table.—The wells from which the samples were taken have been arranged and numbered serially as far as possible in accordance with their locations, progressing from East to West on the map. The approximate location is indicated in the table either by the name of the nearest road or in some cases by the name of the district (Kiangwan). As a help towards locating the position of any particular well, the map has been marked in squares and the square in which the site of the well falls is also given in the table. Where waters from different levels of the same boring have been tested, they are tabulated under the same well number but differentiated by the letters A, B or C.

Depths.—The depths are given in feet. Those marked with the qualifying letter (C) have been obtained either from the Boring Company who sank the well or from other equally reliable source. The other depths are "stated" depths, i.e. the depth given in answer to enquiry from the firm or individual on whose property the well is situated. In some cases where, in my judgment, there is doubt as to the accuracy of the stated figure, a qualifying letter (D) has been attached and a short note inserted at the bottom of the table.

Date of Test.—The date of test bears no relation to the age of the well but is merely the date of the laboratory test of the water. Many of the samples were tested during the sinking of the well and in the case of the majority of the waters tested during the latter half of 1926 and onwards, the date of test corresponds approximately with the age of the well. Other samples are from wells which at the date of test had been in operation for greater or lesser periods of time. Some of the borings listed were never put into use on account of the nature of the water obtained and others are known to be no longer in use but the analyses of the waters are presented as still being of value in showing the type of water found at the particular depth in the localities where the wells are situated.

Chemical Figures.—The samples have been subjected mostly to what is termed a "Sanitary" analyses, i.e., the determination of the suitability of the water for domestic and/or drinking purposes and the results are given in the usual form. In the case of partial analyses only, dashes have been inserted opposite the tests or determinations omitted. In the case of the last item in the column (alkaline bicarbonate in terms of Na_2CO_3) it is perhaps unnecessary to state that free alkaline bicarbonate or carbonate cannot be present where permanent hardness exists.

The hardness determinations are all by standard acid and alkali and not by soap test and the figures therefore can be taken as giving as accurate an indication of the nature of the hardness forming salts present (calcium and magnesium carbonates in carbonated (temporary) and sulphates and chlorides of calcium and magnesium in non-carbonated (permanent) hardness) as can be obtained without actual detailed determinations of the elements and radicles. Complete mineral analyses have been made of several of the waters and in many others calcium and magnesium have been determined and the calculated hardness from the amounts of calcium and magnesium and acid radicles found, has been in very close agreement with the hardness determined by the titration method with acid and alkali. The figures expressing hardness are actually the equivalents of the hardness forming salts in terms of calcium carbonate in parts per 100,000 (French Degrees).

Note.—As several countries have different methods of expressing degrees of hardness, the definitions and equivalents are given for information.

English Degrees (Clark's scale) are grains per Imperial Gallon of calcium carbonate ($CaCO_3$).

United States of America, either grains per U.S. Gallon or parts per million, of calcium carbonate ($CaCO_3$).

French Degrees are parts per 100,000 of calcium carbonate ($CaCO_3$).

German Degrees are parts per 100,000 of calcium oxide (CaO).

Parts per 100,000 (French Degrees)		*Parts per million*		*Grains per Imp. Gallon*		*Grains per U.S. Gallon*		*German Degrees*
1	=	10	=	0.7	=	0.58	=	0.56

Mineral Analyses *(See Appendix B)*

The figures from complete mineral analyses of several of the waters listed are given for the information of those who may be interested in the composition of the dissolved mineral matters in the waters.

The locations of the wells are indicated by circles which enclose the serial numbers as used in the tables. Where two or more wells are in close proximity, two or more serial numbers are enclosed by the same circle.

General Consideration of the Results of Analyses

Some of the features revealed by the analyses may be of more interest to chemists than to engineers, but all are of importance in connection with water supplies.

Total Dissolved Solids.—No water has yet been examined which contains less than about twice as much dissolved mineral matter as is normally present in Shanghai Waterworks water. The lowest figure recorded is 29.4 parts per 100,000 and the general limits within which the total dissolved solid contents of the 161 original samples examined, fall, are

2	have total dissolved contents of	30 and less	parts per 100,000.
33	,,	31-40	,,
33	,,	41-50	,,
28	,,	51-60	,,
16	,,	61-70	,,
14	,,	71-80	,,
11	,,	81-90	,,
24	,,	over 90	,,

In the previous paper a somewhat arbitrary classification of the waters there tabulated, in which there were comparatively few alkaline waters, was based on the amount of total dissolved solids and the waters were placed in four classes according to whe-

*Transactions of *The Engineering Society of China*, Paper No. 3. Vol. XXX.

ther the dissolved solid contents were :—A—less than 45, B—between 45 and 76, C—between 76 and 100 and D—over 100 parts per 100,000. Consideration of the figures of analyses of the waters from the larger number of wells now tabulated reveals no natural lines of division for such a classification and, in fact, if the waters were tabulated in order of increasing dissolved solid content an almost uniform progression would be evident, in which the difference between each water and the next was hardly more than one unit. A further objection to a classification on this basis is the fact that the total dissolved content is not a regular function of any one, or of all, the important mineral characters of these waters. A higher total solid content as a rule includes an increased chloride content (salinity) but is very often associated with a lesser degree of hardness and with a proportionately higher alkaline bicarbonate content. An objectionable amount of oxidizable iron may be found as readily in a water of low as in a water with much higher content of dissolved solid contents. A classification based solely on total dissolved solids content therefore does not fully reveal the character of the water and hence no attempt at such a classification has been made in the present paper.

As an indication of the variations in composition which may be shown by waters which have very similar contents of total dissolved solids, average figures as also the highest and lowest figures, for the more important mineral characters of the waters with total dissolved contents between 30 and 90 parts per 100,000 are given in the following table. The least variation occurs, as would be expected, in the figures for the sum of hardness and alkaline bicarbonate contents, not only between waters in the same group in respect of total dissolved contents but also generally over the whole of the groups averaged.

	A. *Total Dissolved Solids*	B. *Total Hardness*	C. *Alkaline Bicarbonate as* Na_2CO_3	*Sum of B + C*	D. *Chlorine Chlorides*
	Parts per 100,000.				
Limits of A—30 to 40, 33 waters.					
Highest	40.0	32.7	15.9	32.7	10.8
Lowest	31.5	13.5	0.0	19.9	1.5
Average	35.8	25.1	—	27.3	4.7
Limits of A—40 to 50. 33 waters.					
Highest	50.0	36.0	23.3	36.2	12.5
Lowest	41.0	11.0	0.0	26.0	3.5
Average	45.2	23.6	—	31.5	7.8
Limits of A—50 to 60. 28 waters.					
Highest	59.0	40.5	23.6	40.5	22.4
Lowest	50.4	13.0	0.0	25.5	4.6
Average	54.8	24.4	—	34.4	12.2
Limits of A—60 to 70. 16 waters.					
Highest ..	69.8	46.5	26.5	46.5	27.6
Lowest	60.4	11.5	0.0	30.0	8.2
Average	64.6	27.0	—	28.4	15.9
Limits of A—70 to 80. 14 waters.					
Highest	80.0	47.5	26.2	47.5	31.5
Lowest	71.0	16.0	0.0	29.5	14.0
Average	75.6	32.4	—	40.9	22.0
Limits of A—80 to 90. 11 waters.					
Highest	89.0	46.5	20.7	46.5	31.0
Lowest	80.5	19.0	0.0	30.5	20.0
Average	84.2	28.4	—	39.8	25.3

Organic Purity.—The amount of free or saline ammonia which, in ordinary waters (surface, river, etc.), is usually considered as one of the indications of freedom or otherwise from organic contamination is, in nearly every case, excessive when considered from the point of view of an analyst. If a surface water containing such amounts of free ammonia was met with it would be almost unhesitatingly condemned as being practically raw sewage. The presence of these excessive amounts of free ammonia in the deep well waters is, however, accompanied by very low figures for oxidized nitrogen (nitrates) and a practically total absence of nitrites and of nitrogen in organic combination, determined as albumenoid ammonia. In polluted waters, such amounts of free ammonia would be accompanied by significant amounts of albumenoid ammonia and of nitrites and nitrates. Actually the true deep well waters are organically very pure and it is only where contamination with surface water has occurred that organic impurity is present. Properly constructed deep wells in Shanghai should yield waters which are sterile or, if not absolutely sterile should be, within the ordinary limits of test, free from harmful bacteria. The presence of free ammonia in these deep well waters therefore is not an indication of a present or recent organic pollution. It is undoubtedly derived from the reduction of nitrates originally present in the water by the action of iron compounds present in ferruginous sand. For ordinary uses the presence of these large amounts of free ammonia (large in comparison with amounts usually found in potable waters) would hardly be considered detrimental. It might be troublesome in laboratories and for production of distilled water.

As deep well waters are normally of a high degree of bacterial purity it is perhaps desirable to emphasize the necessity of avoiding any possibility of contamination in storage tanks and distribution systems, particularly in Shanghai where subsoil water may be grossly polluted.

Iron.—Practically all the deep well waters in which permanent hardness is present and also many of those with no permanent hardness and in which a few units only of alkaline bicarbonate are present, contain appreciable and in very many instances objectionable, amounts of iron. In these latter, the water as pumped from the well may be clear but almost immediately on aeration it loses its transparency and acquires either a yellow turbidity or even a definitely rusty appearance, according to the amount of iron present. If the water is raised by air lift it may be turbid when pumped owing to precipitation of the iron by the aerating effect of the air lift in its passage up the bore tube. On standing at rest the iron will sediment out, leaving a clear or slightly opalescent water above. The iron precipitate is in the form of an oxy-carbonate or a mixture of oxy-carbonate and hydrated oxide. This iron is frequently referred to as "oxidizable iron."

The definitely alkaline waters are free from more than traces of iron and, with few exceptions, are perfectly clear and bright.

As previously stated, there is an undoubted connection between the presence of these objectionable amounts of iron and the large amounts of free ammonia so generally present in the waters and it is interesting to record that a decrease in the iron content noticed in several waters has been accompanied by a marked decrease in ammonia content and an increase in nitrate content. The water from well No. 137, in use since 1925, is now practically free from both iron and ammonia, actual figures for the last three years being.

	1930	*1931*	*1932*
Iron	0.13	0.012	0.008
Ammonia	0.240	0.004	0.003

The water from well No. 139B on the last occasion of testing showed a similar change to an almost complete absence of iron and a complete absence of ammonia. These observations indicate that the ferruginous layer active in the case of these particular wells is not unlimited in extent or that it eventually becomes exhausted in respect of its reducing action on the nitrates in the water.

The presence of large amounts of free ammonia and yet only traces of iron in many of the alkaline waters may be explained by similar exposure to a ferruginous layer in which the nitrates are reduced to ammonia and a subsequent passage through a zeolite layer in which the water is given its alkaline character, the iron being there precipitated and removed by a natural filtration.

The presence of an appreciable amount of iron is a very serious objection to the use of any water for domestic purposes, not only from its unsightly appearance but from its staining action on linen, etc., and an iron deposit may be detrimental in many technical operations, apart from domestic use. In the Manual of the American Waterworks Association it is stated that :—"Experience has shown that iron, if present in excess of 0.5 parts per million (0.05 parts per 100,000)—expressed as Fe—will generally be objectionable to consumers. With pure ground water 0.3 parts per million is the limiting amount beyond which complaints of deposition and staining are to be expected. In waters containing considerable organic matter a content of 1 part per million or over may be tolerated without complaint." Thresh states :—"Where a water contains over 0.1 part of Iron (Fe) per 100,000 parts, troubles always arise if it is not removed." From my own observations

I can state that a deep well water containing over 0.05 parts of iron per 100,000 parts is never perfectly clear and that with 0.1 parts per 100,000 the water will have a definitely yellow turbidity.

It is important that samples of deep well water for analysis should be taken as the water issues from the bore tube and not from a tank or storage system in which sedimentation may have occurred, as in the latter case the true iron content of the water may not be shown.

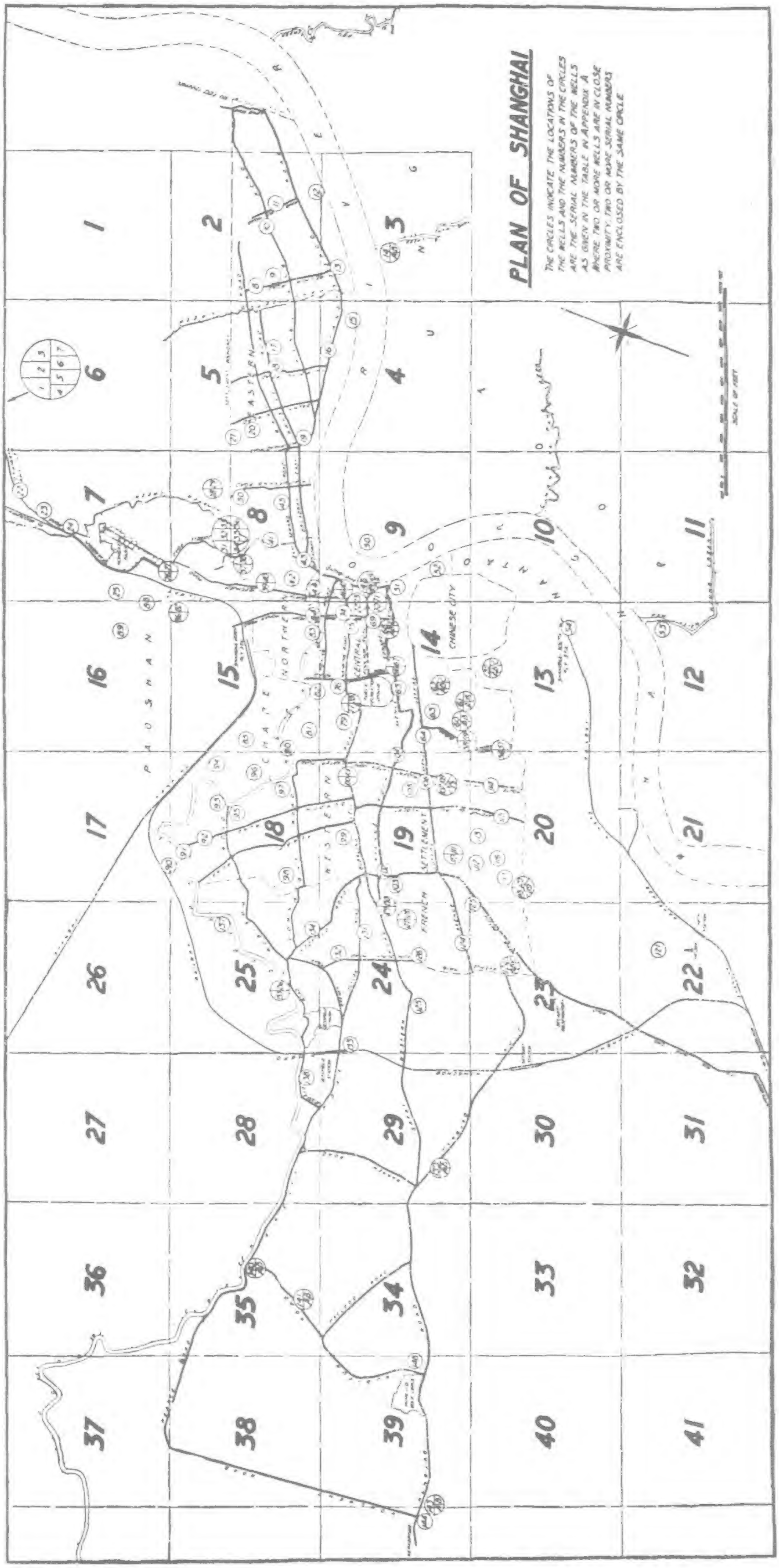
It is perhaps unfortunate that deep well waters such as Nos. 1 to 7 in the table, which have low total dissolved solids contents should contain objectionable amounts of iron as this precludes their use for ordinary domestic purposes without a suitable filter installation, the satisfactory control of which demands knowledgeable supervision. They are eminently suited for combined softening and filtration treatment where such a course is economic.

In the table of analyses, quantitative figures are found against iron in most of the waters but in some of the earlier analyses the iron content has been noted only as a "trace" or as "heavy." Those noted as heavy contain iron in objectionable amount and it is possible that in some of those marked as "trace," the true iron content was not shown owing to the sample having been taken from a storage tank and not from the bore tube.

Manganese.—Although it is generally recognized that manganese occurs in most waters where iron is present, its presence in deep well waters here was rather forcibly brought to notice by a brownish black deposit which had collected in the pipes of a service system in which a chlorinated well water of a non-alkaline type was being used. This deposit was found to consist of oxides of manganese. Further tests showed the presence of manganese in other well waters containing iron and that in the particular case quoted, the oxidizing action of the chlorine which was being applied to the filtered water caused the precipitation of the manganese as an insoluble oxide. By chlorinating the water before, instead of after, filtration the manganese was retained on the filter and not deposited in the pipes. The amount of manganese found in the waters tested is around 0.014 parts per 100,000.

Poisonous Metals.—No copper or lead have been found in any of the waters. A trace of zinc has been noticed in three samples but this has undoubtedly originated from galvanized tubes or storage tanks.

A considerable number of these deep well waters have been tested for arsenic and minute traces were found in almost every one of the waters tested. The amount found has varied from 1 part in 250,000,000 parts to 1 part in 50,000,000 parts of water. One part in 50,000,000 parts is equal to 1 millegram in 50 litres or 1/64 grain in 11 gallons. As 1/64 grain of arsenious oxide is the ordinary minimum medicinal dose by the mouth and 11 gallons of water would have to be drunk to get that amount one can safely



say that the amount present is negligible so far as potability is concerned. Experiments indicate that in the waters containing iron, most of the minute trace of arsenic separates out with the precipitated iron oxy-carbonate when the water is aerated.

Hardness and Alkalinity.—None of the waters can be termed really soft waters, although a few of the alkaline waters very nearly approach softness. The majority of the non-alkaline waters are definitely " hard " and some fall in the class of very hard waters. The alkaline waters vary in degree from being moderately hard to hard. The average hardness of the waters with total dissolved contents of 90 parts or less per 100,000 is 26 parts per 100,000, the highest and lowest figures being 47.5 and 11 parts per 100,000 respectively. The average hardness of Whangpoo river water is in the neighborhood of 8.5 parts per 100,000. The alkaline bicarbonate content is of course very evident in the waters with the lowest hardness figures.

In a discussion on Hardness, Thresh (The Examination of Waters and Water Supplies) says: " When 30° (30 parts per 100,000) of hardness is approached the water becomes very objectionable for washing purposes but towns in this country have public supplies of greater hardness and there is no doubt they are perfectly wholesome." He further says: " If the hardness exceeds 50° (50 parts per 100,000) then it can safely be declared as 'unfit for general domestic purposes.' If the hardness is chiefly permanent and especially if due to magnesium salts, the unfitness would be emphasized but even then it could not be definitely certified as 'unwholesome.' "

Considering the figures for hardness alone, on the basis of Thresh's evaluation quoted above, only those deep well waters with a total hardness figures well below 30 parts per 100,000 would be considered desirable for general use. Not that the others would be termed " unwholesome " but that the hardness is greater than desirable in water intended for general purposes, mostly on account of its soap destroying properties. Apart from distinctly unwholesome or objectionable features e.g. excessive iron, the least highly mineralized and the least hard water is the most desirable for general purposes and, where alternative sources of supply are available, the choice would fall upon the water which best complies with these requirements, given that it is of equal organic and bacterial purity as an alternative source. This is without reference to economic considerations or to special purposes for which a supply may be intended. Waters which show little or on permanent hardness would be viewed more favorably than if the hardness were composed of both the temporary and permanent types.

Frequent reference has been made in the preceding pages to the " alkaline " waters. These are waters which contain not only no non-carbonated (permanent) hardness but also a reduced carbonated (temporary) hardness and a character definitely alkaline from the presence of free alkaline bicarbonate in amounts varying from 1.6 to 28 parts per 100,000 expressed in terms of sodium carbonate (Na_2CO_3). Actually this is present in solution as sodium bicarbonate ($NaHCO_3$) but on evaporation it is weighed in the solid residue in the form of the normal carbonate (Na_2CO_3) and hence is quantitatively expressed as such in the table of analyses. As the water stands with free exposure to air a certain small amount of normal carbonate becomes evident and on boiling, more of the bicarbonate is transformed into the normal carbonate.

The majority of these alkaline waters are perfectly clear and bright but an occasional one has been met with in which a slight haziness, due to very fine sand—not iron—has been met with.

Similar alkaline waters from deep wells are common. Again quoting Thresh.—" Sodium Carbonate—This salt occurs occasionally in waters from the most diverse geological formations, but is especially common in the London Basin in the waters derived from the lower London Tertiaries and the chalk beneath. The amount present may vary from 2 or 3 parts to 50 parts of carbonate per 100,000, the latter approaching in character some of the greatly vaunted 'table' waters. These alkaline waters have been used over large areas for generations, and are of the highest repute for their purity and wholesomeness."

From the point of view of wholesomeness there is little objection to the use of an alkaline water provided that the alkalinity is not excessive. Indeed many consider them very palatable drinking waters, though it is possible to imagine that a connoisseur of tea might object to the flavor of an infusion made with an alkaline water, particularly as on boiling the bicarbonate may be partially converted into the normal carbonate which has a somewhat less pleasant taste. The amount of bicarbonate converted into the normal carbonate will vary with the time of heating and with long continued boiling most of the bicarbonate will be decomposed.

Whether these alkaline waters are equally unobjectionable for general trade or factory uses, apart from domestic uses, is more doubtful. There are certain trade operations in which they might be decidedly objectionable, others in which they might even be advantageous. It is conceivable that for steam raising a decided amount of alkaline bicarbonate might be objectionable under certain circumstances. It has already been remarked that when an alkaline water is boiled a certain amount of the bicarbonate is decomposed into the normal carbonate (and carbon dioxide) and at much higher temperatures this decomposition may be carried a step further with the production of sodium hydrate (caustic soda) and further carbon dioxide. The caustic soda formed by this latter decomposition is considered by many to be the essential causative factor of embrittlement and protective chemical treatments have been devised for use with alkaline boiler waters. Others state that the effect of caustic soda in itself is not sufficient to cause embrittlement and that protection against this is best afforded by careful construction to avoid excess stresses and permeable seams.

The characters of these alkaline waters suggest a partial softening of a hard water by contact with or filtration through a natural zeolite (a silicate of aluminium and sodium). The calcium and magnesium in the original water are partially replaced by sodium from the zeolite, sodium sulphate and chloride replacing calcium and magnesium sulphates and chlorides, and sodium bicarbonate replacing (not completely) the calcium and magnesium bicarbonates. This property of zeolite is utilized in some commercial softening processes e.g. the Permutit process. Waters can be softened down to zero point, with the production of an alkaline water where carbonated hardness is present in the original water. The reaction is a reversible one, hence the necessity, in a zeolite system, of revivifying the zeolite by regular periodic treatment with brine which results in the calcium and magnesium radicles fixed in the material being again replaced by sodium.

From this necessity of regular revivification of the material which is present in zeolite filters arises the speculation as to whether the softening action of these natural layers in the water-bearing strata will continue indefinitely or whether, at some future date, signs of exhaustion will become apparent, as has been noticed in the case of one or two wells in continued use, in connection with the reducing action of the ferruginous layer which results in the iron and ammonia contents of deep well waters.

The hydrogen iron concentrations of those waters tested are within the range pH 7.8 and 8.1.

Saline Constituents.—Chlorine (in chlorides) in the waters examined increases more or less in proportion to the total dissolved solids. Generally, chlorides are present in the waters in the form of sodium chloride (common salt) and the figure for chlorine multiplied by 1.65 gives a fairly accurate indication of the weight of the chloride present. In waters which have a considerable degree of permanent hardness and in which little or no sulphates are present the chlorine is present in the form of calcium or magnesium chloride. Both these compounds are more objectionable than sodium chloride not only in respect of taste but also, in the case of magnesium chloride particularly, in respect of possible corrosive action in boilers. In waters which are alkaline and in those in which little or no permanent hardness is present without alkalinity, the chlorine may safely be assumed to be present in the form of sodium chloride. In other waters the state of combination can be ascertained by determination of constituent elements and radicles. The excessive amounts of chlorine present in some of the highly mineralized waters are suggestive of sea water admixture or contact with some saline deposit.

Most palates will detect a slightly saline taste in water containing 50 parts per 100,000 of sodium chloride (30 parts per 100,000 of chlorine in sodium chloride). Much smaller amounts of calcium or magnesium chloride would give a disagreeable flavor to a water.

Logs of Borings *(See Appendix C)*

The logs of the borings which appeared in the original paper are again reproduced as a matter of interest. With two exceptions, no attempt has been made to present a larger number as it was

APPENDIX A

RESULTS OF ANALYSES OF DEEP WELL WATERS; PARTS PER 100,000 (TO CONVERT INTO GRAINS PER IMPERIAL GALLON × 7/10)

1	Number	1	2	3	4	5	6	7	8	9	10	11	12	1
2	Location	Kiang-wan	Kiang-wan	Kiang-wan	Kiang-wan	Kiang-wan	Kiang-wan	Kiang-wan	Ward Road	Yang-tszepoo	Ping-liang Road	Lin-ching Road	Nr. Pingting Road	2
3	Map Square	Off 6.	Off 6.	Off 6.	Off 6.	Off 6.	Off 6.	Off 6.	2	2	2	2	2	3
4	Depth	300′ to 350′	396′ (C)	280′	280′	450′ to 480′ (D)	300′ (C)	260′ (C)	ab. 350′	310′ (C)	320′	450′ (C)	375′ (C)	4
5	Date of Test	12.4.26	30.8.24	8.6.24	8.6.24	20.3.25	8.7.25	13.4.31	15.3.26	25.4.32	17.3.26	5.1.32	19.1.24	5
6	Total solids	30.0	29.4	33.2	43.2	32.5	42.4	32.0	54.8	39.2	38.0	31.5	45.2	6
7	Hardness—Total	23.1	20.0	21.3	28.0	23.5	30.0	25.0	39.0	27.0	29.0	19.5	31.0	7
8	(*a*) Carbonated (Temporary)	23.1	20.0	21.3	28.0	23.5	28.0	25.0	25.5	23.0	24.5	19.5	23.0	8
9	(*b*) Non-Carbonated (Permanent)	0.0	0.0	0.0	0.0	0.0	2.0	0.0	13.5	4.0	4.5	0.0	8.0	9
10	Chlorine in chlorides	3.0	2.5	2.7	5.5	1.7	6.4	1.5	16.6	7.5	6.9	3.65	12.5	10
11	Nitrogen as nitrates	0.22	Trace	Trace	Trace	0.009	0.017	—	Trace	—	0.149	0.012	0.009	11
12	Saline Ammonia	0.164	0.187	0.145	0.296	0.241	0.295	—	0.072	—	0.019	0.030	0.128	12
13	Albumenoid Ammonia	Nil	Nil	Nil	Nil	0.005	0.007	—	—	—	—	Nil	0.001	13
14	Poisonous Metals (Pb. Cu. Zn)	—	—	—	—	Nil	Nil	—	—	—	—	Nil	Nil	14
15	Nitrites	—	Nil	—	—	Nil	Nil	—	Nil	Nil	Trace	Nil	Nil	15
16	Sulphates	—	Nil	—	—	Trace	Trace	—	Nil	Nil	Trace	Trace	Trace	16
17	Oxygen absorbed in 1 hour @ 37°C.	—	0.137	0.119	0.178	0.121	0.121	—	—	—	—	0.028	0.039	17
18	Iron (Fe)	0.19	Trace	0.2	0.8	Trace	0.3	0.16	0.08	0.09	0.04	0.24	Trace	18
19	Alkaline bicarbonate in terms Na CO	2.7	3.2	4.4	3.0	2.1	Nil	0.5	Nil	Nil	Nil	1.05	Nil	19

considered that anything short of a complete list of logs corresponding to the wells would be of little value and the compilation of a complete list was too heavy a task to undertake. The two exceptions are those which are not numbered and are of wells which have been sunk since the table of analyses was complied. They are situated in the Gordon Road—Soochow Creek locality and are of interest in that the two borings are only thirty feet apart and yet a definite difference in formation is shown by the logs. The seven original logs are of borings which are situated on a line running roughly East and West (from Pootung to Hungjao.) All show fairly deep sand layers around 300 feet and those which have been carried deeper show sand layers round about 450 or 500 feet.

During the last few years the general trend of well boring operations appears to have been towards the sinking of deeper wells in order to reach the clear alkaline waters without exploring the chemical characters of the waters met with in shallower strata. This is understandable in view of the characters of many of the waters from wells at shallow depths but the comparative lack of data in regard to the upper levels makes it difficult to give any more than a very sketchy survey of this part of the paper. From the data available it would appear that a water bearing stratum may be general at a depth round about 300 feet but that the quality of the water obtained is not constant. In the Eastern and North-eastern parts of the area the water from this approximate depth has a generally low total dissolved solid and chloride content but also generally contains iron in amount which would be objectionable. As one goes West and South the water apparently becomes more highly mineralized and saline. The clear alkaline waters are found at greater depths, generally from about 500 feet downwards over the greater part of the area but even these waters are not of uniform composition, fairly wide variations in chloride, hardness and alkaline bicarbonate contents being evident. The area in the vicinity of Siccawei appears to be an exception to this general statement as the few borings in this area of which I have records show hard and saline waters down to a depth of 750 feet.

The waters as pumped have a temperature of 66°-68°F (19°-20°C.)

APPENDIX B.—MINERAL ANALYSES OF DEEP WELL WATERS

	Water-works water (5.9.32)	DEEP WELL WATERS					
		No. 43 (1925)	No. 71 (1932)	No. 99 (1932)	No. 100 (1925)	No. 125 (1925)	No 140B (1925)
	Parts per million (Milligrams per liter).						
Calcium Carbonate ($CaCO_3$)	87.5	164.2	82.0	133.2	264.0	257.9	86.5
Calcium Sulphate ($CaSO_4$)	—	—	—	—	1.4	1.6	—
Calcium Chloride ($CaCl_2$)	—	—	—	—	42.1	253.3	—
Magnesium Carbonate ($MgCO_3$)	11.5	80.3	46.0	98.3	—	—	46.0
Magnesium Sulphate ($MgSO_4$)	18.3	—	—	—	126.3	—	—
Magnesium Chloride ($MgCl_2$)	—	—	—	—	—	176.3	—
Sodium Carbonate (Na_2CO_3)	—	25.0	232.0	143.7	—	—	203.4
Sodium Sulphate (Na_2SO_4)	3.1	3.8	24.4	37.3	—	—	2.7
Sodium Chloride (NaCl)	26.1	25.4	58.5	421.2	103.4	164.6	49.6
Sodium Nitrate ($NaNO_3$)	—	—	—	—	1.8	—	0.6
Potassium Chloride (KCl)	2.5	15.5	21.0	20.4	22.3	14.7	12.4
Potassium Nitrate (KNO_3)	7.2	0.2	1.8	2.8	—	—	—
Iron Oxide (Fe_2O_2)	0.07	1.8	0.35	0.15	5.4	6.7	0.4
Alumina (Al_2O_3)	0.33	2.3	1.85	0.45	1.8	3.3	2.0
Silica (SiO_2) or	8.00	—	28.6	30.0	—	—	—
Silica and Sodium Silicate	—	28.4	—	—	36.9	35.0	16.7
Total mineral constituents	164.6	346.9	496.5	887.5	605.4	913.4	420.3

Note.—The mineral analyses were made on samples taken at different times from the samples which were subjected to the ordinary analysis. The year in which the analysis was made is given for information and a mineral analysis of Shanghai Waterworks water as taken from the mains in September 1932 is also given as a matter of interest. The compounds or salts tabulated are the probable combinations (in order of probability as given by Thresh) of the basic and acidic elements and radicles determined by analysis. Carbonates, though returned as normal carbonates, are actually present in solution as bicarbonates.

Waters No. 71 and 140B are representative of alkaline waters which have fairly low chloride contents whilst No. 99 shows an alkaline water of an appreciably saline character. No. 43 is a water of low total dissolved solids content with a faintly alkaline character and iron in amount which would prove to be objectionable in use. In water No. 100, the permanent hardness forming salts are calcium chloride and magnesium sulphate and a very objectionable amount of iron is present. Water No. 125 contains practically no sulphates and the permanent hardness forming salts are chlorides of calcium and magnesium. This is an objectionable type of water apart from the amount of iron present.

The substance of this paper does not lend itself to anything in the nature of "general conclusions." A general idea has been given of the characters of the water obtained from deep borings in Shanghai and information in respect of depths and locations presented in a form which, it is hoped, may be helpful to any one who is interested in the subject. The characters of the waters have been further briefly discussed in relation to their general suitability for ordinary uses.

The origin or source of supply of the deep well waters in the Shanghai area is an interesting speculation, as on the correct answer may depend the expectation of permanence or of ultimate exhaustion. I can offer no decided views of my own on this point but can briefly refer to theories which have been advanced and which may serve as a basis for discussion or for future investigation. The hypothesis of sand pockets or "lenses" in which definitely limited volumes of water are stored was advanced by Prof. G. H. Cressey in a paper entitled "The Geology of Shanghai" Dr. H. Chatley, in a personal communication in 1931, quotes Terzaghi's work on the pressure in and flow of water through porous material as possibly bearing on the Shanghai deep well water supply, the lenses or pockets envisaged by Prof. Cressey being fed by water which is being slowly squeezed out from the thick layer of mud which overlies the water-bearing sand layers. Both these theories postulate eventual diminution and ultimate exhaustion of supply and further involve the likelihood of ground settlement in proportion to the volume of water pumped out. Whether these are the correct explanations of the deep well water supply or whether, as considered by some, there are other sources of replenishment, may be revealed at some future date.

In conclusion I have to express my indebtedness to the China Deep Well Drilling Company for the logs of borings and permission to use the figures from the analyses many samples of water sent in by them for test and for information in regard to depths and locations. Also to the Eastern Engineering Works for similar permission and information in regard to samples sent in by them. Also to those other firms and gentlemen mentioned in the original paper. Lastly I have to thank your secretary, Mr. N. W. B. Clarke, for his assistance in connection with the map and the chart of logs of borings.

APPENDIX C.—Logs of Borings

Log of Four Inch Well No. 82.
(per China Deep Well Boring Co.)

Depth.	*Formation.*
10′–134′	Clay
134′–150′	Fine yellow sand
150′–170′	Sand
170′–290′	Clay
290′–300′	Sand
300′–322′	Coarse sand
322′–385′	Black fine sand
385′–392′	Coarse sand with pebbles
392′–445′	Sticky clay
445′–455′	Fine sand and mica
455′–484′	Coarse sand

Log of Four Inch Well No. 132.
(per China Deep Well Boring Co.)

Depth.	*Formation.*
10′–128′	Clay
128′–153′	Yellow sand
153′–235′	Sticky clay
235′–270′	Sand and gravel
270′–278′	Sandy clay
278′–280′	Dark sand and sea shells
280′–295′	Coarse sand and gravel

Log of Four Inch Well No. 140.
(per China Deep Well Boring Co.)

Depth.	*Formation.*
5′–160′	Clay and mud
160′–185′	Fine sand
185′–190′	Clay
190′–222′	Fine sand
222′–230′	Clay
230′–232′	Coarse sand with sea shells
232′–246′	Fine sand
246′–250′	Coarse sand
250′–268′	Fine sand
268′–299′	Grey sand with pebbles
299′–340′	Mica sand
340′–442′	Sticky clay
442′–500′	Grey sand

Log of Six Inch Well No. 48.
(per China Deep Well Boring Co.)

Depth.	*Formation.*
10′–210′	Clay
210′–254′	Black fine sand
254′–263′	Grey sand with pebbles.
263′–270′	Fine black sand with mica
270′–278′	Grey sand
278′–320′	White coarse sand with pebbles.

Log of Six Inch Well No. 142.
(per China Deep Well Boring Co.)

Depth.	*Formation.*
0′– 16′	Surface mud
16′– 62′	Sandy clay with some shells
62′–106′	Fine black sand with mica and shells
106′–138′	Coarse sand and shells
138′–162′	Blue clay
162′–220′	Stiff clay with a little gravel and shells
220′–245′	Clay
245′–262′	Coarse sand with thin layers of clay
262′–278′	Gravel with a little clay resembling shale
278′–289′	Coarse sand

Depth	*Formation*
289′–243′	Coarse sand
343′–381′	Clay with a little gravel
381′–402′	Clay with a little gravel
402′–404′	Clay
404′–455′	Sand
455′–467′	Clay
467′–481′	Yellow clay
481′–540′	Yellow clay and a little gravel
540′–657′	Yellow clay with particles of gravel
657′–682′	Fine sand
682′–702′	Yellow clay
702′–724′	Sand with particles of clay
*724′–735′	Sandstone or cemented sand
*735′–751′	Fine whitish sand
*751′–754′	Sandstone or cemented sand
*754′–761′	Coarse sand and gravel or pebbles
*761′–769′	Clay
769′–798′	Coarse sand
798′–802′	Hard sandstone
802′–810′	Yellow clay
810′–813′	Hard sandstone
813′–837′	Greyish sand
837′–855′	Sandstone fairly hard
855′–872′	Coarse sand
872′–877′	Hard conglomerate
877′–893′	Hard conglomerate with thin layers of yellow clay
893′–902′	Hard conglomerate with limestone predominating

The screen pipe is placed between 724′ and 757′, the bottom section being plain pipe to the bottom 902′.

* Screen pipe.

Log of Four Inch Well No. 14B.
(per China Deep Well Boring Co.)

Depth.	*Formation.*
10′–100′	Clay
100′–105′	Blue clay
105′–112′	Yellow clay
112′–130′	Sticky clay
130′–210′	Yellow sand
210′–252′	Clay
252′–258′	Fine sand
258′–287′	Black fine sand
287′–300′	Coarse sand
300′–313′	Clay
313′–351′	Sand and gravel

Artisan Well No. 53.
(per Messrs. Eisler, Reeves & Murphy).

Depth.	*Formation.*
125′	Black and yellow earth
80′	Yellow sand
100′	Black sand
80′	White mixed sand
20′	Coarse sand
22′	Earth—grey
56′	White mixed sand
7′	Earth—grey
18′	White sand
56′	Earth—black and hard
30′	White mixed sand
3′	Yellow sand

A. Log of Ten Inch Well
(per China Deep Well Drilling Co. 17.2.33.)

20′– 95′	Sand and clay
95′–125′	Black clay
125′–195′	Shell and clay
195′–230′	Black clay
230′–275′	White medium sand
275′–322′	White coarse sand
322′–330′	Grey fine sand
330′–364′	Black clay
364′–405′	White medium sand
405′–438′	White and black coarse sand
438′–444′	Black fine sand

B. Log of Ten Inch Well
(per China Deep Well Drilling Co. 17.2.33.)

20′– 75′	Sand and clay
75′–116′	Blue clay
116′–134′	Yellow fine sand
134′–287′	Black fine sand
287′–393′	White fine sand
393′–428′	White medium sand
428′–442′	Grey medium sand
442′–470′	White medium sand
470′–478′	Yellow fine sand
478′–506′	Blue clay
506′–592′	Yellow clay
592′–600′	Yellow fine sand
600′–680′	Grey clay
680′–691′	White medium sand
691′–702′	White coarse sand
702′–788′	Blue and yellow clay
788′–814′	Yellow fine sand
814′–868′	Yellow clay
868′–889′	Grey fine sand
889′–910′	Grey clay
910′–930′	Conglomerate

These two borings are only 30 feet apart.

Wireless Station at Kebajoran, Java, Completed

In order to relieve the Malabar station near Bandoeng of some of its international wireless traffic, the Netherlands Indian Government constructed a powerful wireless station at Kebajoran, near Batavia. Trials have been made, and it is expected that the station will be placed in service shortly. The masts of the aerials are about 60 meters (196 feet) high, and it is hoped that many of the difficulties that have attended wireless and broadcasting in the Netherland Indies will be overcome. A mast of 90 meters (295 feet) will be set up in the near future.

The "Roadorail" Transport System*

By W. J. WILLIAMS, M.I.E.E., M.I.Mech.E., M.I.Struct,E.

THE loss of traffic on railways ascribed to competition from road vehicles is a question which has been exercising the minds of railway administrations in all parts of the world for some considerable time. It has been contended by the advocates of road transport that motor lorries, motor omnibuses and charabancs, are more flexible than railways because they are in a position to pick up merchandise or passengers at warehouses or domiciles as the case may be, and deliver them where they are desired to be deposited at the point of destination.

Road vehicles undoubtedly have a decided advantage in this respect over railways, and on this account a good deal of handling of goods is obviated and is confined to loading at the despatching end and unloading at destination, whereas in the case of a railway double handling has to be resorted to at both ends. Strenuous attempts are being made by railway companies in all parts of the world to solve this difficulty by a combination of road and rail transport, and some of these devices have already been in operation for some time with some success.

The "Roadorail" Transport system is intended to assist the railways in recovering some of the traffic which it has lost, and is based on the principle that goods have to be collected, transported, and delivered with the least possible amount of delay and labor, and by the shortest route. It is hardly necessary to point out that the "Roadorail" system has distinct advantages over road transport in the Federated Malay States, as tortuous roads and steep passes are characteristic of the country, whereas the railway takes as direct a route as possible and steep gradients are avoided.

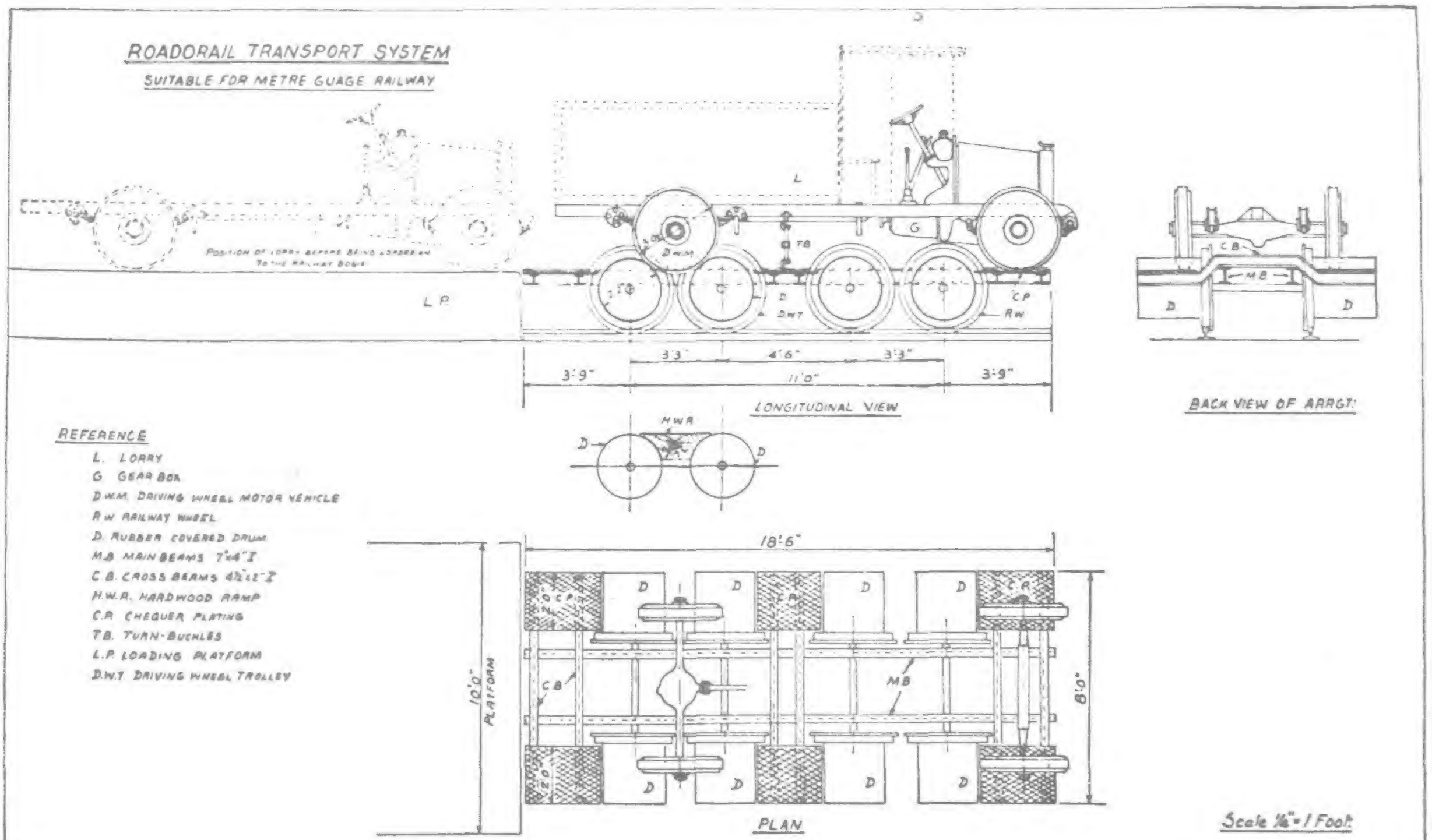
The system consists of a specially designed bogie for the conveyance of road motor vehicles along railway lines. Its main feature is that the motive power for driving the bogie along railway lines is derived from the motor vehicle which is being transported, and that complete control of the combined outfit is dependent upon the equipment of the road vehicles. The bogie can be designed and constructed to suit any railway gauge, and to accommodate any size of road motor vehicles whether for goods or passenger traffic.

To accomplish the above operations, the bogie is equipped with suitable wheels for running on railway lines as shewn in Fig. 1. The bogie ordinarily is equipped with four pairs of wheels and these are so arranged that two pairs are placed close together at each end. To each of these wheels a drum is attached or forms part of the wheel, or the drum may be mounted separately on the same axle as the wheel. The drums are covered with tough rubber, similar to "linatex," and the wheels of the bogie are fitted with roller or ball bearings so that friction is reduced to a minimum.

The bogie is also fitted with bumpers or buffers to prevent shock when coming into contact with the loading—platform and a hand operated brake is provided to secure the bogie when not in use.

The road motor vehicle proceeds from the loading platform under its own power and takes up a position so that the rear wheels rest between the two sets of drums. It is then secured to the bogie by means of couplings on either side, which can be tightened by means of a turnbuckle similar in design to that connecting together two railway carriages. The combined equipment is then ready to start on its journey by the manipulation of the road vehicle's equipment. It is controlled entirely as if the road vehicle were running on the road, and the combined unit responds to the forward or reverse gears and brakes of the road motor vehicle. The road motor vehicle is equipped with three or four forward gears and the same number for the reverse gears. When the bogie is travelling forward, the engine of the road motor vehicle will be in reverse, and when the bogie is travelling backward the engine of the road motor vehicle will be in forward gear.

*From Quarterly Journal of *The Engineering Assoicaton of Malaya*



When the combined unit reaches its destination, the bogie is fixed to the loading platform, the couplings securing the road vehicle to the bogie are uncoupled and the vehicle departs, takes to the road once more, and delivers its load where it has to be deposited.

There is no reason why several bogies should not be coupled together to form a train, should conditions warrant it, and on arrival at destination they take to the road once more and proceed individually to consignees' doors.

The " Roadorail " System offers the following advantages :—

(1) Solves the road and rail transport problem.
(2) Is a means of regaining traffic for railways.
(3) Cuts out the steep passes and winding roads which road vehicles have to traverse.
(4) Enables the collection of goods or passengers to be made by the railways and to effect direct delivery at destination.
(5) Saves handling and storage of goods at railway yards.
(6) Enables the most direct route to be taken between receiving end and destination.
(7) Avoids delay in the transportation of goods.
(8) Makes fuller use of the permanent way.
(9) Is equally adaptable for passenger and goods traffic.
(10) Considerably helps the rubber industry as the rubber covering on the rollers will require periodical renewal.
(11) Eliminates heavy locomotives which consume fuel even when idle.
(12) Reduces congestion on main roads.

A working model of this system has been built by the writer (who is also the inventor). This model represents a working unit circulating round a curve of 396 feet radius on a meter gauge railway, and travelling at the rate of 50 miles per hour.

Commercial Aviation in China

(Continued from page 402)

Commercial aviation is therefore only in its infancy in China, and future development depends largely on the provision of more machines and a larger flying personnel, not only for opening up fresh routes, but for keeping reserve machines and pilots and speeding up the service on those already existing. This is, of course, a matter of money, but not money alone. There is also another important consideration. There can be no really satisfactory development of civil aviation in China until the necessity for importing foreign machines and foreign pilots and experts has passed. A native flying personnel is gradually being trained, this does not present so much difficulty, but there are very great obstacles in the way of the native manufacture of planes. China possesses the raw materials, but lacks the basic industries which produce the high grade manufactured materials necessary for the construction of modern aircraft. At the same time the building of aeroplane engines and aeroplanes in general is a highly technical and specialized business, which is not mastered in a day or two. However, though none of the proposals for the establishment of manufacturing companies have as yet borne fruit, a start has been made towards the building of native planes. The aeronautical department of the Naval Ministry has turned out ten or so seaplanes which have proved practical for training purposes. All of them have had to be fitted with imported engines however. In the most recent, which has a speed of 120 m.p.h., a lifting power of 1,116 kilograms and a ceiling of 3,810 feet, Mr. Tseng, Director of the department, plans to make a distance flight along the Yangtze valley and the southern coast, visiting in all seven provinces.

Neither company can be said to be at the moment in a financially prosperous position. Actual figures and balance sheets are not available, but neither has yet shown a profit. Indeed both are dependent on their air mail contracts for the greater portion of their income, and these contracts are largely in the nature of a subsidy rather than an economic payment for services rendered. In consequence they are frowned on in some quarters, especially by the Post Office, which objects to having, as it asserts, to carry these " babies " of the Ministry of Communications at the expense of its own cheaper working. Strictly speaking there may be something to be said for this point of view ; the financial purist would no doubt say that, if there has to be a subsidy, it should be made direct out of the national exchequer and labelled as such, rather than in this indirect fashion out of the funds of another department. But from the practical point of view, if it is necessary to foster aviation and a subsidy is required for the purpose, it seems that it might as well be given in this way as in any other.

Of the need to foster commercial aviation there can be no question. Already the two companies have proved their worth. machines of the China National Corporation did invaluable service during the floods of 1931 in carrying supplies, conducting surveys, and transporting officials. Only recently one of the latest acquired machines of the Eurasia Corporation was detained at Lanchow on its flight out from Berlin in order to carry General Huang Mu-sung, the National Government Pacification Commissioner to Sinkiang, from Suchow to Urumtchi. The bringing of outlying provinces into closer contact with the administrative and business centers of the country, of which this is an example, is indeed a vital necessity. Roads and railways will of course ultimately have to be made, but these take years to construct and necessitate a tremendous initial outlay. In the meanwhile air services can be established at far less initial cost and in much shorter time. They may not be at the start profit-making concerns, neither for that matter are roads and railways, the former indeed are not expected to be so at all, but they will become so. Already the China National Corporation is developing as the figures show. Business men are discovering, for example, the convenience of getting to the north in one day instead of four. The Eurasia Corporation's route to Europe, once satisfactorily organized, seems bound to become immediately popular. The saving of time it represents in regard to mail matter and certain types of goods such as films, machine spare parts, etc., let alone to individuals with important business to transact is tremendous. Although, therefore, at present no actual pecuniary return is to be seen for the capital and energy that has been expended, there are no grounds for pessimism. Indeed considering the great difficulties, financial, political, and geographical that have had to be overcome, the actual progress that has been already made is every reason why we should be optimistic.

The Royal State Railways of Siam

(Continued from page 412)

locomotive in Siam, the Diesel machines being allowed half a ton more.

The six Garratts were designed to haul 530 ton goods trains up grades of 1 in 42, but, in view of the light lines of the northern and north-eastern routes, they are not required to run faster than 28 m.p.h. They scale 115½ tons in total weight, with 81½ tons available for adhesion, and have a maximum tractive effort of 41,675 lbs. Despite a wheelbase of 64 feet, they can traverse 4½-chain curves, but it was found desirable to construct a special shed for these engines at Korat.

Included in the passenger stock are six first class and five second class convertible sleeping cars, and six restaurant cars, while the bogie passenger stock totals 235, against 63 four-wheeled vehicles. The Royal Saloon, and many of the passenger and goods vehicles were constructed by Craven's Railway Carriage and Wagon Works at Sheffield, but the recent goods stock orders have been booked by French firms. The wagon stock is noteworthy by reason of including 25 bogie and 50 four-wheeled hopper wagons of all-steel construction, but there is only one refrigerator van in the list. The rolling stock inventory also includes four 25 ton breakdown cranes, one steam tramcar, and a prison van !

At the moment of writing, the Khonkaen line is being pushed on to the northern frontier at Nong Kai, and from this extension a branch has been surveyed, by air, eastward, to link up with the Indo-Chinese Mekong line at Nakorn Panom. Other recent works include the doubling of the north main line from Bangkok to Bang Phaji Junction, 51 miles, where the northern and north-eastern main lines diverge.

The Johore Pumping Station for the New Water Supply for Singapore

In connection with the huge project of obtaining a new water supply fo· Singapore from Johore, described in *The Far Eastern Review* for May, 1932, details of an article devoted to the pumping plant of the project, as published in *The Engineer* are of interest.

Tracing the history of the project it is to be recalled that an investigation was carried out by the late Mr. S. G. Williams, M.INST.C.E. as to the possibilities of a water supply from the southern portion of Johore State. Messrs. Sir Alex. Binnie, Son and Deacon of Westminster, were appointed to examine and advise upon various plans and recommended the scheme which they later designed and carried out. The Johore Scheme adopted utilizes the catchment areas of four main streams. Of these, the largest, Pontian Kechil, is at an elevation such that the water requires to be pumped three and a half miles to a filter station common to all the catchments, whence it gravitates through 33 miles of pipe line to Singapore.

The final capacity of the pumping station will be 24,000,000 gallons daily, divided among eight units each of 3,000,000. Of these, three units have so far been installed, though the pump-house is built for the ultimate capacity. The total head, including friction, to be imparted is 340-ft., so that the water horse-power per set is 215.

The question of the type of pumping plant to be employed was given very full consideration by the consulting engineers, and they eventually recommended a plant consisting of vertical three-throw ram pumps, placed over the suction channel, and driven through gearing by heavy oil engines. Of the other types of plant available, special consideration was given to the oil-engine-driven centrifugal pump, corresponding tenders and running costs being carefully compared. As is always the case, the decision as to whether or not to employ the rather more expensive, but more efficient, reciprocating pumping plant depended mainly on the anticipated load-factor, which here proved great enough to justify its adoption. Questions of flexibility, in which the reciprocating pump driven by an oil engine has the advantage, also had their weight with the consultants, who, in addition, were not uninfluenced by the importance of maintaining the efficiency in future years, especially in view of the type of labor available. Pumps manufactured by Messrs. Hathorn, Davey and Co., Ltd., Sun Foundry, Dewsbury Road, Leeds, and driven by Crossley-Premier horizontal oil engines were finally selected.

As regards the decision to use a horizontal engine, this was partly due to the good accessibility of this type, and partly to the better distribution of weight on the foundations. The exceedingly satisfactory guarantees given by the Premier Gas Engine Co., Ltd., not only for fuel-oil consumption, but also for that of lubricating oil, also played their part. It is said that the decision reached has so far amply justified itself by results, the engine guarantees being actually improved upon.

The pumps, illustrated in Figs. 3 and 4, are of the vertical three-throw type, giving a cycle which delivers water, and absorbs power, at a sensibly steady rate. There is thus no perceptible shock in the delivery mains nor in the gearing : and, in fact, it is stated that it is not easy to tell when facing away from the plant which set is running, so smooth is their operation.

The pump rams are 15¼-in. in diameter, and the stroke is 2-ft. 6-in. Multiple valves are fitted, made entirely of phosphor bronze, and arranged in groups for easy inspection and removal. They are of the Veering type, in which the water-load is taken metal to metal, but the joints are sealed by overlapping tough chrome-leather rings. Thus even should the metallic surfaces eventually become abraded, slipless running will continue. The stream-line form of the waterways through the valves, whereby even the small velocity energy generated is largely recovered, is shown in Fig. 4. Over each set of delivery valves is a large air-vessel, the three being interconnected so as to form virtually one large air-vessel for each set, so that pressure-variations, in any case small due to the three-throw action, are rendered entirely negligible. The rams and ramcases are of standard type, each ramcase being stayed to the crank-shaft bearings on either side of it by heavy ties. The ties are sufficiently inelastic to prevent the communication to the foundations of an appreciable degree of variable stress. This feature is common to all recent plants made by the manufacturers, and is a precaution against foundation trouble after a set has been in use for a number of years.

The pumps are driven by the engines through reduction gearing, the engine speed being 250 r.p.m., and the pump speed 36.5 r.p.m. The gears were manufactured by Messrs. David Brown and Sons (Huddersfield), Ltd., and are housed in oil-retaining steel gear-cases. Flexible couplings, of the Wellman-Bibby type, are fitted between the pinion shafts and engines, but there are no clutches, the engines being easily capable of starting against the torque of the pumps when the starting by-passes on the latter are open. The lubrication of the rotating

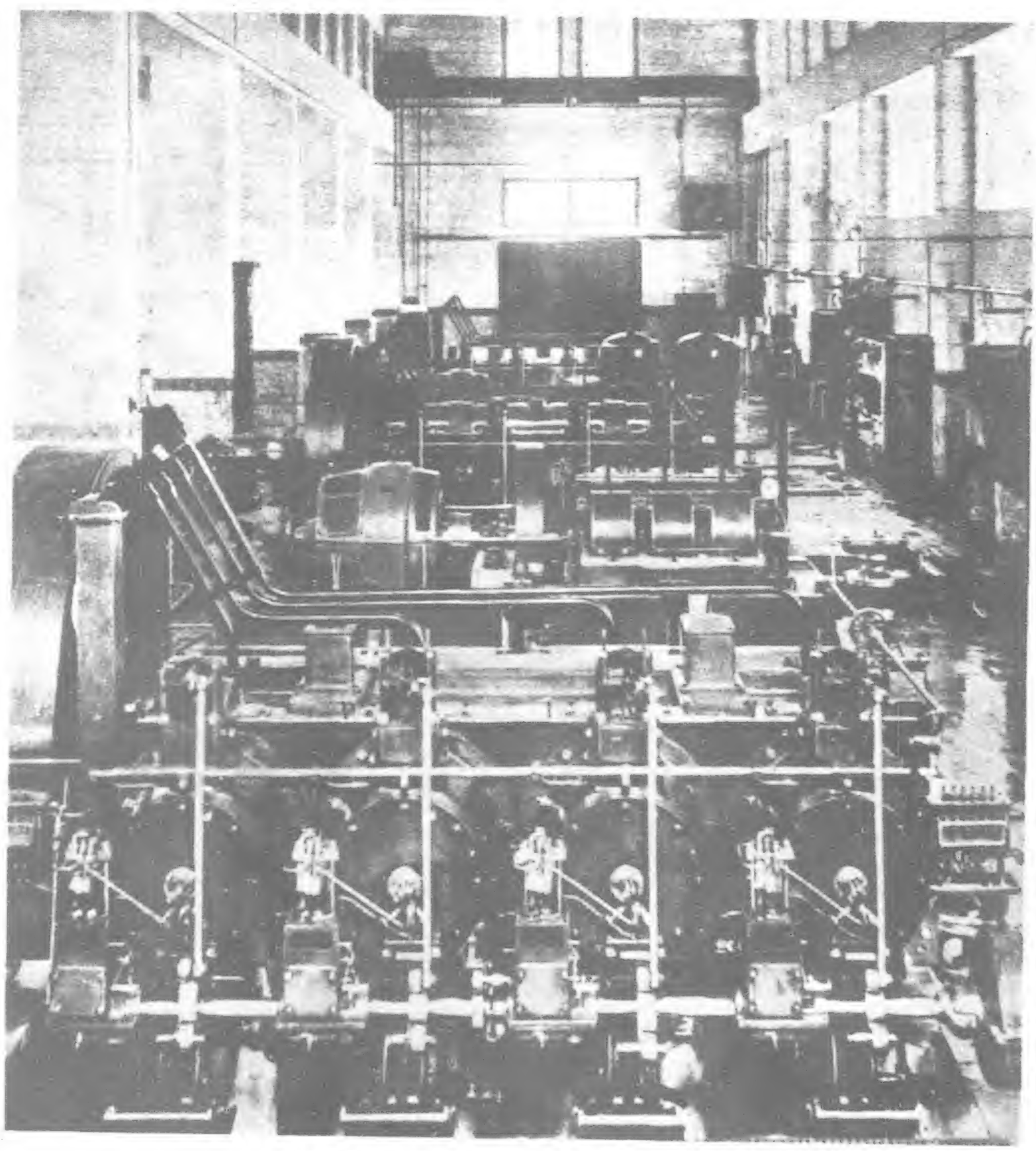


Fig. 1.—General view of Engine Bay

mechanism is entirely automatic, all surplus oil being collected and re-used. Reference is made later to a lubricating oil filter for this purpose. It should be mentioned that the lubricating gear was removed from the plant before the photograph reproduced in Fig. 3 was taken.

The oil engines, shown in Figs. 1 and 2, have four cylinders, and are of the Crossley-Premier horizontal type. The cylinder diameter is 14½-in., and the stroke 24-in., and the engines have a nominal horse-power of 330. The consulting engineers specified that the rating should be 25 per cent in excess of the maximum power required by the pumps. In view of the level fuel consumption characteristic of these oil engines, this margin is no disadvantage, and is particularly necessary where continuous running under tropical conditions has to be undertaken. Although the chief features of these engines, such as the formation of the cylinder liner and breach end in one casting, have already been described in our columns, a brief reference may not be out of place to the characteristics which render them particularly suitable for pumping duty. As they operate on the four-stroke cycle, the four cylinders give a very even turning moment, and this, in combination with the rigidity secured by forming the four water-jackets as a single casting, ensures very smooth running and quiet operation of the gearing. With reference to speed control, attention may be drawn to one point often overlooked when designing plant for reciprocating pump drive through reduction gearing. The pump designer is not generally concerned about speed fluctuations during the pump cycle, provided these are of reasonable extent. In the case of single-acting pumps, the torque varies greatly during each cycle, and the designer would prefer the engine to draw on its fly-wheel energy during peak loads rather than that efficiency should be sacrificed in an attempt to burn enough fuel to maintain steady speed. Coarse governing is, therefore, actually an advantage under the conditions considered, though, as pointed out above, the three-throw action of the pumps at the Johore station ensures a steady torque and close governing can be applied, if desired. It is particularly important in stations where native labor is employed that routine maintenance should present a minimum of difficulty, and in the Crossley-Premier engines the valves are arranged for good accessibility and are provided with duplicate springs, each alone being able to close the valve ; a broken spring can be replaced without stopping. Special attention has been given to lubrication, a horizontal engine offering particular advantages in this respect. An interesting feature in the layout of these engines is the design of the silencer, exhaust pipes and chimneys. The arrangement is such that an induced draught is created in the chimneys by the exhaust, thus giving effective ventilation, an item of paramount importance in a tropical engine-house.

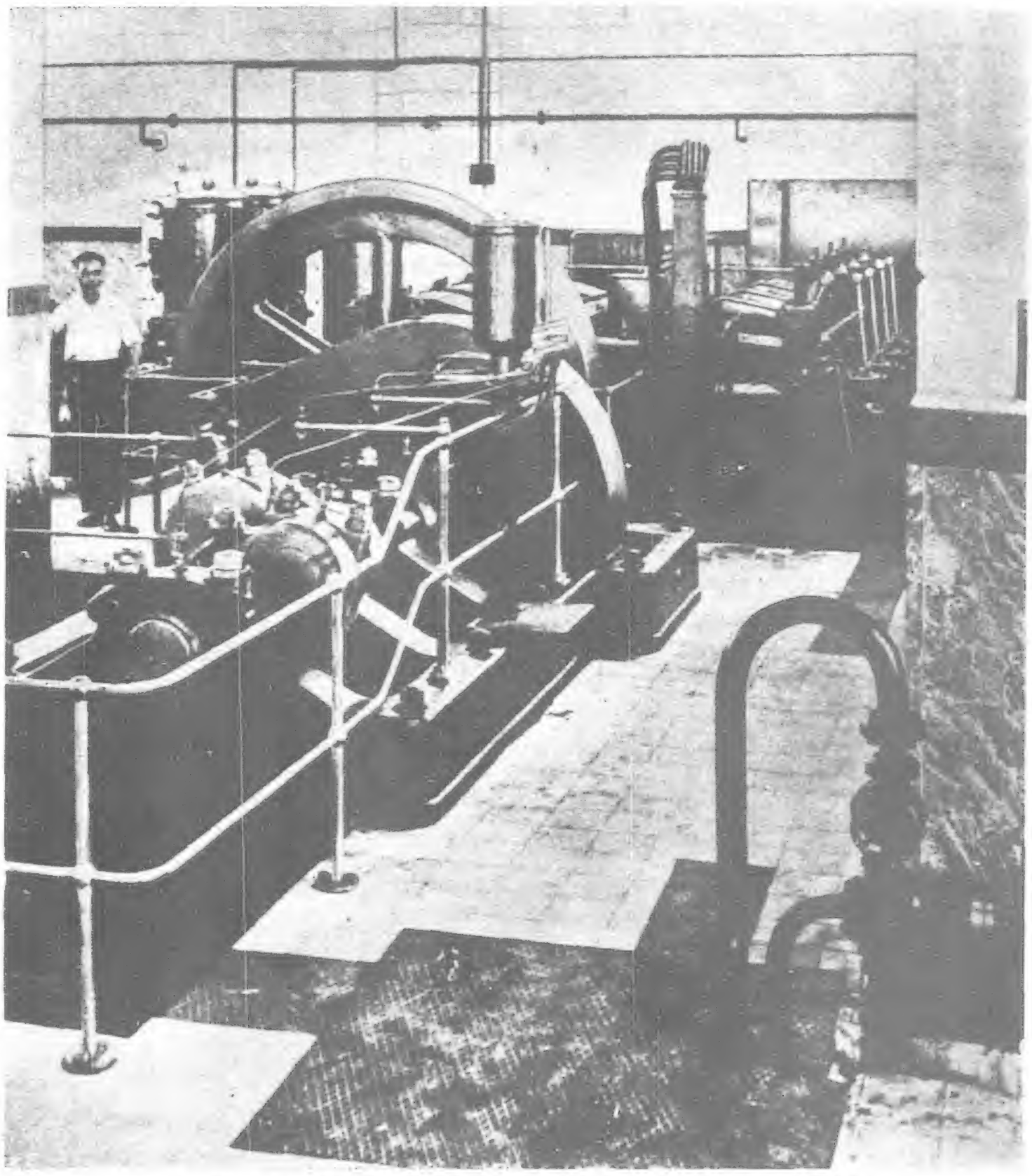


Fig. 2.—Reduction Gear between Engine and Pump

Turning now to the auxiliary plant, there is a plentiful supply of flowing water available at the station, and coolers of the immersed tubular type were therefore adopted, the exceptionally liberal cooling area being provided owing to the tropical temperature, reaching about 83 deg. Fah., of the water pumped. As a precaution against over-cooling, each cooler is provided with an adjustable by-pass. The compressed air for starting the engines is normally provided by two electrically-driven Robertson air compressors, with a petrol-paraffin driven compressor for initial starting. The power for these, for the screen-house crane, oil purifiers, oil heaters, cooling-water circulating and drainage pumps, and also for lighting the station, is provided by two 66-brake horse-power generating sets, driven by horizontal Crossley-Premier oil engines, the electrical machinery being by Messrs. Crompton, Parkinson, Ltd. The fuel-oil purifiers were made by Messrs. The British Separators, Ltd., of York, while those for the lubricating oil are of Fox type. The drainage pump mentioned, which is capable of emptying the suction channel if required, is one of Messrs. Hathorn, Davey's well-known vertical Helivane models. The gauges, instruments, etc., necessary for the efficient running of the station, include a bomb calorimeter.

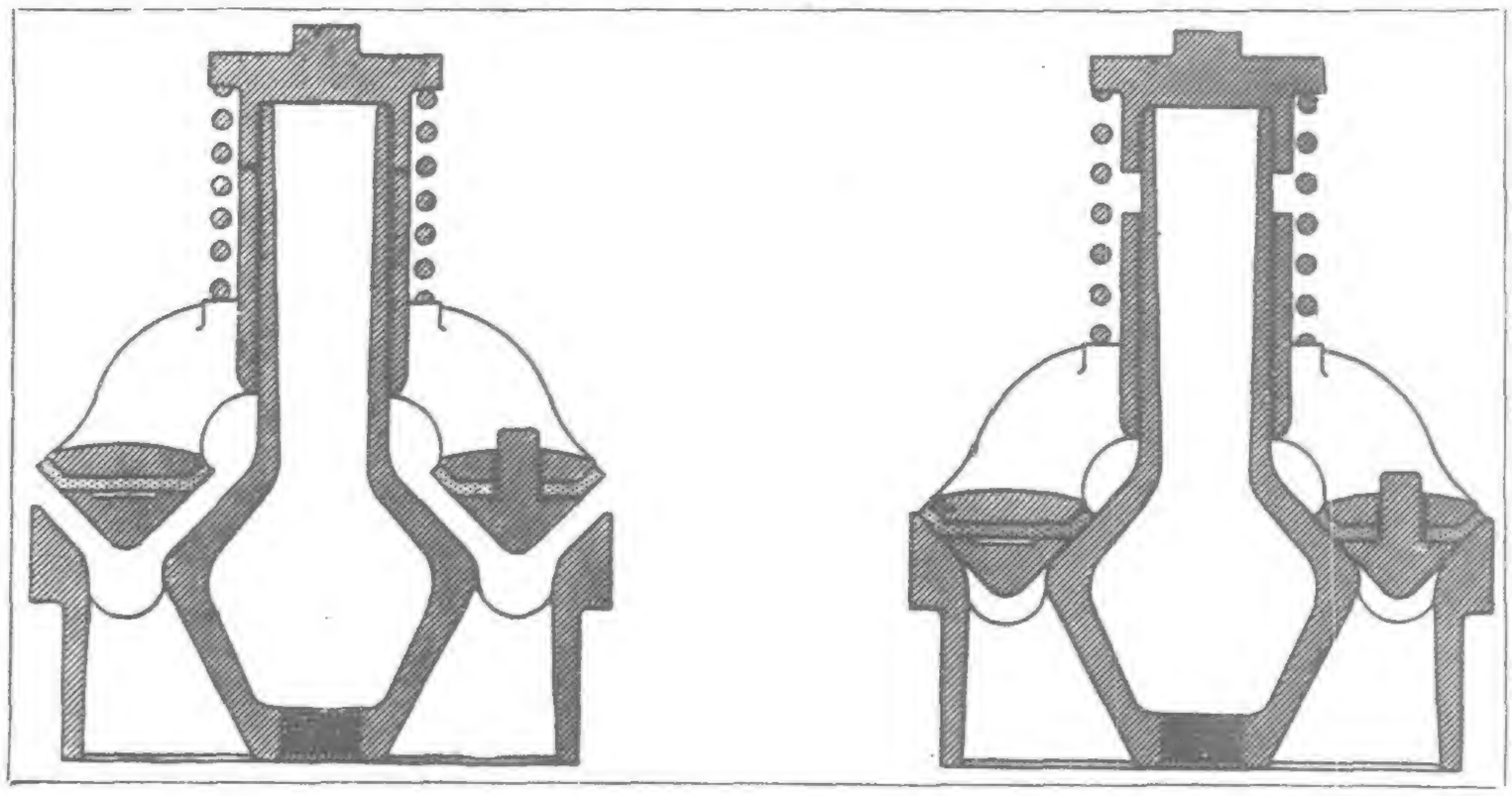


Fig. 4.—Water passages through Pump Valves

	No. 1 Set.	*No. 2 Set.*	*No. 3 Set.*
Total head by gauges, constant throughout test (ft.)	285	284	284
Quantity, by displacement (gallons per minute) ..	2,160	2,161	2,192
Mean W.H.P. during test, by displacement	186.6	186.3	188.8

Fig. 3.—View with engine house floor removed of Hathorn-Davey Three-Throw Pump

	No. 1 Set.	*No. 2 Set.*	*No. 3 Set.*
Mean fuel-oil consumption per hour	77.08	76.5	78.4
Mean oil-consumption per W.H.P. hour, by displacement ..	0.413	0.411	0.415
Calorific value of oil (A.P.C.) B.Th.U. per lb., gross ..	19,140	19,140	19,140
Lubricating oil per engine hour (pints)	0.321	0.351	0.455

The duty of each set is 3,000,000 Imperial gallons per day, against a head of 340-ft., and a guarantee was given that at full pumping load each set would use, per w.h.p.-hour, not more than 0.466 lb. of oil, of a calorific value of 18,500 B.Th.U. per lb. It was further guaranteed that the lubricating-oil consumption should not exceed 1.06 pints per engine hour. These guarantees were considerably improved upon, as indicated by the test figures given in the table above, which were obtained during official tests of approximately 7½ hours' duration.

It will be seen from the table that, even without adjustment for calorific values, the guarantees were very materially improved upon. A correction which further increases this improvement is, however, required for a fair comparison. The consumptions were guaranteed on a fuel of a net calorific value of 18,500 B.Th.U. per lb., corresponding to a gross value of very nearly 19,600 B.Th.U. per lb. The oil used on test had a gross calorific value of 19,140 B.Th.U. per lb., so that, to reduce to guarantee conditions, a factor of 0.976 is applicable to the consumptions given above. These, then, become respectively 0.403, 0.401 and 0.405 lb. per displacement w.h.p.-hour.

It might be of interest to mention that before the official trials were run, an unofficial 24-hour trial on No. 3 unit, under corresponding conditions, yielded a result of 0.394 lb. of oil per displacement w.h.p.-hour, or 0.384 lb. adjusted to guarantee conditions.

All the above figures are based on displacement water horsepowers. Measurements were taken, though not at the official trials, of slip, the rate of filling of an open tank of approximately 853,000 gallons being observed. The results obtained were, for No. 1 set, 2.7 per cent ; for No. 2 set, 1.88 per cent ; and for No. 3 set, 1.64 per cent. In the case of No. 1 set, however, the water-level readings were taken with difficulty, owing to the wind, and it would, therefore, seem that an average of about 1.75 per cent is the most likely figure for slip. If the above figures for oil-consumption per displacement w.h.p.-hour are adjusted by this amount to give consumptions in lb. per useful w.h.p.-hour, they become 0.420, 0.418, and 0.422, and in the case of the preliminary tests, 0.401, or, if the above figures are adjusted to guarantee conditions, the consumptions would be 0.410, 0.408, 0.412 and 0.391, respectively. It will be generally admitted that these figures represent a very high performance, on which the makers of the plant are to be congratulated.

The New Capital

A total of $20,000,000 will be spent in construction work in Hsinking, Capital of the new State of Manchoukuo.

The Government of Manchoukuo is spending $3,600,000, including $1,500,000 for public buildings, $900,000 for avenues and roads, $600,000 for water mains and $400,000 for sewerage and $200,000 for parks and athletic fields.

The Kwantung Army is spending $2,850,000. The Kwantung Government is building a new post office, other public edifices and residences for its officials, costing altogether $660,000.

The S.M.R. Co., other large corporations and individuals are devoting nearly $9,400,000 in building work. Additional school structures, new police stations, larger telephone and telegraph offices, a new Japanese embassy and other items are estimated to cost altogether $2,000,000.

Missing Russian Turbine, "Lost" 17 Years

If machines could talk, a certain turbine-generator set recently brought to light near Moscow would have a thrilling tale to tell. Completely lost sight of for a period of 17 years, this electrical machinery has lived through the World War and the Russian Revolution without ever being removed from its packing case, and to-day, except for certain missing parts, is ready to be pressed into its long-delayed service, none the worse for its experience.

In 1916 the General Electric Company of N.Y. built and shipped to the Imperial Russian Government a 360-kilowatt turbine-generator set. The shipment was made to Riga, it is believed, but when the city was approached by the German army, the machine was evacuated to a location near Moscow. Before it could be installed the revolution occurred, and in the confusion incident to the following civil war the equipment was entirely lost sight of. Only recently was it found near Moscow—but strangely enough it was 50 miles removed from the nearest railway. How it reached its present site, and what befell it there while an empire fell and other governments were established, remains a mystery.

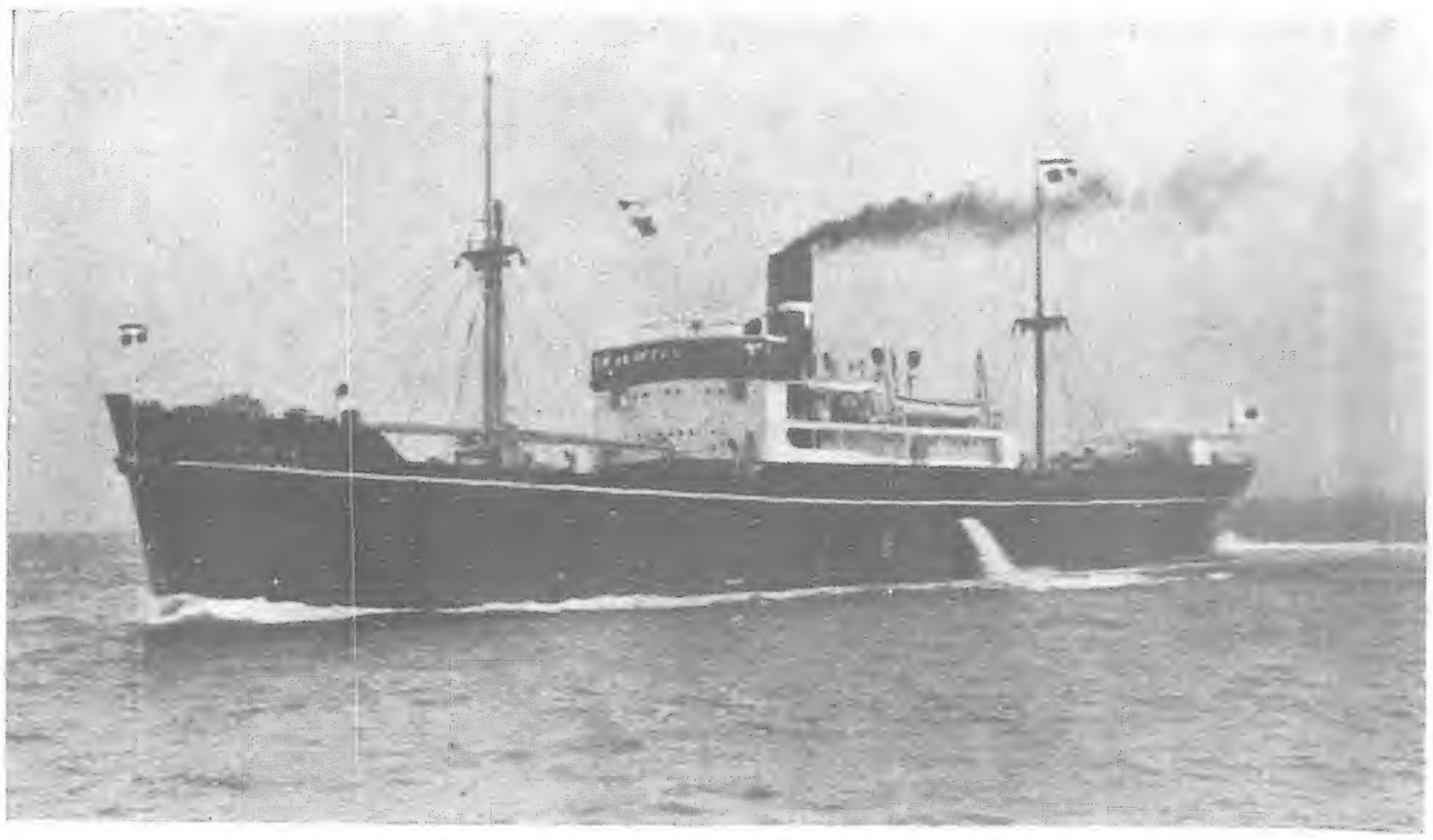
The story of the turbine generator has just reached Schenectady through Ernest Pragst, manager of the Moscow engineering office of General Electric. The Soviet government is contemplating the purchase of parts to replace the missing ones and expects to put the machinery into service.

The turbine-generator, when found, was with a quantity of other machinery, probably delivered to a site where a new plant was to be erected. No records have been found in Russia to explain its presence on the spot. The original instruction book and records relating to the machine were located, however. Considering the length of time that has elapsed, engineers have reported that the apparatus is in exceptionally good order. The packing case was removed from the unit only a short time ago. The original skids are still under it and are in good condition, indicating that there had been no unduly rough handling. The turbine casing had never been opened, and the temporary cover plates used at the inlet and exhaust of the casing are still in place. The casing about the coupling was opened and the latter was found to be in perfect condition, with the original oil slushing still protecting the surfaces.

Recent Development of Exhaust Steam Turbine Systems in Japan

By Y. TAJI, M.Eng., M.I.N.A., M.I.Mar.E., etc.

RECENT progress in marine Diesel engineering and motorship construction in Japan has been remarkable. The economy of Diesel engines has been fully realized by Japanese shipowners as well as builders, yet the traditional use of coal cannot be overlooked in Japan. The price of Diesel engine oil in Japan is not only exceptionally high, but its sufficient supply in case of national emergency cannot optimistically be expected.



The s.s. "Shinkyo Maru" built in the Uraga Dockyard on Official Trials

The amount of natural oil products in Japan is too small to maintain all oil engines running even in peace time. On the other hand, the production of coal in this country is fairly abundant even for exportation, although its quality is not generally high grade. Under such circumstances, exhaustive research has been carried on and strenuous endeavor is being made for the liquefication of coal and shale oil production in Manchuria in order to secure an adequate independent supply of fuel oil in the near future.

Thus, coal is still a very important fuel for marine purposes in Japan, and various systems have been adopted and developed for the economical operation of coal burning ships. In fact, the Imperial Navy is still using coal and oil mixed burning boilers for auxiliary vessels, whilst the pulverized fuel burning system has recently been adopted in two newly built passenger and cargo vessels, the *Johore Maru* and the *Nagoya Maru*.* At the same time, exhaust steam turbine systems have also been developed in conjunction with reciprocating steam engines in view of the economy in fuel.

Apart from purely technical considerations, Japan has too much of old tonnage, for which some drastic measures should be taken in order to improve the over-all efficiency of Japanese shipping. Scrapping the old tonnage is one measure, whilst the reconstruction of inefficient ships is another. For the first case, the Government is carrying out a scheme for facilitating new construction under subsidy on the condition of scrapping at least double tonnage of old ships for the replacement, the majority of these new ships being motorships. In the second case, the efficiency of old engines should be improved and some alteration is necessary for general equipment. In this connection, the exhaust turbine and pulverized fuel systems have been introduced, but their adoption has been left to the free will of the shipowners.

Now, the advantages of these installations have been well proved in Japan by newly built ships and reconstructed ships. The aforementioned ships *Johore Maru* and *Nagoya Maru* are new ships with exhaust turbine system and pulverized fuel plant, whilst the s.s. *Konan Maru* is a reconstructed ship, in which has been added a Bauer-Wach's exhaust turbine system to an old reciprocating propelling machinery, but the boiler plants have not been touched. Very recently, the new ship *Shinkyo Maru* has been added, this being equipped with an exhaust turbine system of purely Japanese design and a poppet valve reciprocating engine.

The primary purpose of the adoption of an exhaust turbine in the s.s. *Konan Maru* has been in the economy of fuel consumption, leaving the increase of power as a matter of secondary importance. Very exhaustive and unparalleled experiments and trials were carried out at sea by the builders as well as the ship's engineers in order to ascertain the real economical advantages of this system. The results of these trials and the records taken on actual sea service appear very interesting and useful for marine engineers and naval architects as well as shipowners and operators.

The *Konan Maru* was built and engined in the Mitsubishi Nagasaki Shipyard some fourteen years ago to the order of the Kobe Sanbashi Kaisha, Ltd. She has recently been reconstructed and equipped with the Bauer-Wach's exhaust turbine system which was built by the Mitsubishi Kobe Works, and is now in service between Japan and Australia.

The vessel has a length between perpendiculars of 400 feet, a breadth moulded 54-ft. 6-in., a depth to upper deck 30-ft. 0-in and a full load draught of 24-ft. 7-in., the gross tonnage being about 5,230 tons and the dead weight about 8,400 tons.

The main boilers comprise three sets of marine cylindrical return tube boilers of 14-ft. in diameter, 11-ft. 6-in. in length with a working pressure at 200 lb. per sq. in., a total grate area (for three boilers) 163 sq. ft., a total heating surface (for three boilers) 6,591 sq. ft., and Howden's forced draught is used whilst no superheater has been fitted.

The main propelling machinery is one set of vertical triple expansion engine with a h.p. cylinder of 27-5/16-in., an i.p. cylinder of 44¾-in. and a l.p. cylinder of 75-1/32-in.,with a stroke of 48-in. and a normal output of 1,400 i.h.p. A surface cooling type condenser with a cooling surface of 2,060 sq. ft. is installed, to which an Edward's air pump with cylinders of 26-in. × 24-in. driven direct by the main engine and an independent steam driven centrifugal circulating water pump with an impeller of 23-in. in diam. are provided.

In adoption of the Bauer-Wach's exhaust turbine system, two sets of Mitsubishi-Weir single cylinder lubricating and manoeuvering oil pumps, one Mitsubishi vertical surface cooling type lubricating oil cooler, a complete set of vacuum augmenting installation with kinetic ejector for the main condenser, a steam driven bucket type drain extracting pump for the exhaust turbine, a complete set of lubricating oil tanks, etc., have been installed in the engine room.

The system is 10/120/65/7 standard type, and the exhaust turbine is of a reaction type with seven rows of bladings, the rotor having a diameter of 650 mm. and a hydraulic coupling with a diameter of 1,200 mm. being used. The reduction gear is of a double reduction single helical gear type having the following particulars :—

	No. 1 pinion	*No. 1 wheel*	*No. 2 pinion*	*No. 2 wheel*
No. of teeth	28	390	57	359
Pitch circle diam. in.	5.14225	55.09556	12.21182	74.98484
Outside diam., in.	5.46325	55.41356	12.58282	75.35584
Reduction ratio	10.714	1	6.140	1
Total reduction ratio	65.784		1	
Circular pitch, in.	0.5769606		0.6730641	
Width of teeth, mm.	259		550	
Angle of teeth	29° 58′ 59″		29° 58′ 52.19″	

The reconstruction carried out for the existing engine in adding the exhaust turbine embodied only the enlargement of the exhaust steam inlet of the main condenser and a certain alteration in the exhaust steam piping, whilst the air pump and circulating water pump remain the same.

The design particulars for the installation are as follows :—

Loading condition		*full load*
Sea-going output,	main engine	1,400 i.h.p.
	exhaust turbine	600 i.h.p.
	Total	2,000 i.h.p.
Revolution :	propeller	56 per min.
	exhaust turbine shaft	4,060 per min.

*See *The Far Eastern Review*, April, 1933.

The propeller is of a detachable type with manganese-bronze blades and a cast iron boss, the diameter being 18-ft. 3-in., actual pitch 19-ft. 9.04-in., number of blades four, developed area 96.8 sq. ft., projected area 80.0 sq. ft. and direction of turning right hand side.

The total number of the engine room staff is 19, i.e. one chief engineer, three engineers, three oilers and twelve stokers. These members are to remain the same after the reconstruction.

On the completion of the alteration, various sea trials were carried out, including the trials with or without the exhaust turbine running, official speed trials, exhaust turbine manoeuvering trials, recording of vibration, etc. A typical record of the trials with the turbine in or out is given in Table I.

During three first voyages between Japan and Australia, further trials were carried out by the ship's engineers in order to ascertain the performance of the whole machinery installation and the fuel consumption in actual service conditions. A summary of the results of trials is given in Table II and details of the second trials in Table I. It will be seen from Table II that some 19.4 per cent of coal has been saved when the exhaust turbine co-operated with the main engine. In these sea-going trials, the fully loaded speed was taken at about 10 knots with 1,507 i.h.p. which is far below the designed output of 2,000 i.h.p. The rate of reduction of coal consumption, however, having a tendency of increasing at a higher output, the reduction of coal consumption at 2,000 i.h.p. would correspondingly be higher than that for 1,501 i.h.p.

The s.s. *Shinkyo Maru* was originally built as a stock boat by the Uraga Dockyard Co., Ltd. and very recently purchased by the Chosen Yusen Kaisha, Ltd., for service between Japanese ports and Korean and Manchurian ports. The vessel has a length 295-ft., a gross tonnage 2,608 tons and a dead weight 4,103 tons. Her propelling machinery is of outstanding character, comprising a main engine with poppet valves, an exhaust turbine with double reduction gears, a mechanical flexible coupling and a friction clutch.

The main engine is of a vertical triple expansion type with a h.p. cylinder of 17-in. in diam., an i.p. cylinder of 27-in., a l.p. cylinder of 44-in. and a stroke of 39-in., developing normally 1,000 i.h.p. with the exhaust turbine system at about 70 r.p.m. at propeller. The maximum output of the main engine and turbine is 1,760 i.h.p. at 89 r.p.m. in which 1,100 i.h.p. is developed by the main engine and 660 i.h.p. by the exhaust turbine, whilst the maximum output with the main engine only when the turbine is disconnected is about 1,300 i.h.p.

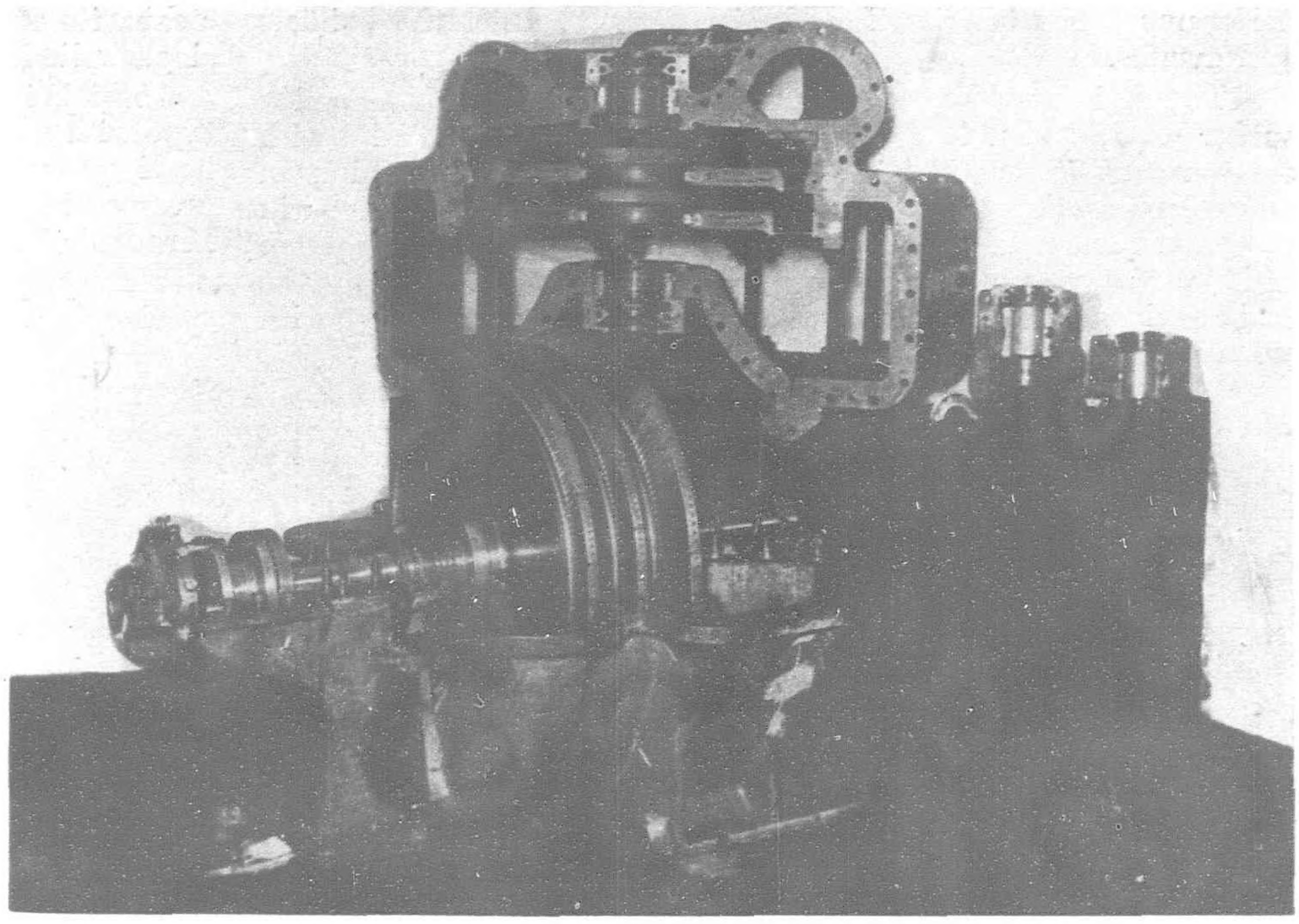


Fig. 1.—Uraga Exhaust Turbine as Overhauled

The h.p. and i.p. cylinders of the main engine have steam and exhaust valves of double beat poppet type, whilst the l.p. cylinder has an ordinary D slide valve. The valve gear is of Stephenson's type with double bar links, whilst the poppet valves are operated by cams and sliding segments which adjust the cut-off of the cylinders.

The exhaust turbine is of a three stage impulse type with stainless steel bladings. The over-all length of the turbine is about 5-ft., the width about 4-ft., whilst the pitch circle diam. of the wheels is 2-ft. 7-in. The exhaust steam discharged from the low pressure cylinder first pass through an oil separator, and by means of a two way valve is delivered either directly into the main condenser or alternatively through a steam strainer into the turbine. Special provision is made for the turbine to be automatically shut off, whenever the main engine has to be reversed.

The reduction gearing is of a double-reduction double-helical type with the following particulars :—

	No. 1 pinion	*No. 1 wheel*	*No. 2 pinion*	*No. 2 wheel*
No. of teeth.. ..	25	141	32	283
Diam. of pitch circle, in.	5.3601	30.2312	6.8610	60.6768
Outside diam., in. ..	5.7311	30.6022	7.2320	61.0078
Reduction ratio ..	5.64	1	8.84	1
Total reduction ratio	.50		1	
Circular pitch, in ..	.673575		ditto	
Width of teeth, in. ..	7		22	
Angle of teeth ..	30 degrees		30 degrees	

Instead of the ordinary hydraulic coupling, a mechanical flexible coupling is used. In this coupling, a number of helical springs are fitted in order to absorb unbalanced torque between the main engine and the exhaust turbine, whilst a frictional disc clutch is provided for connecting and disconnecting the second gear pinion and the first wheel, these discs being spring loaded and lined with asbestos in order to make firm frictional surfaces. In case of disconnecting the gear, the contact is easily released by means of a hydraulic cylinder and piston operated by oil pressure through a lubricating oil pump. A provision is made to simultaneously shut off the exhaust turbine steam inlet when the clutch is disconnected, as mentioned before.

The complete installation including the main engine, exhaust turbine, flexible coupling, frictional clutch and manoeuvering devices is of the special design of the Uraga Dockyard Co., Ltd. and its

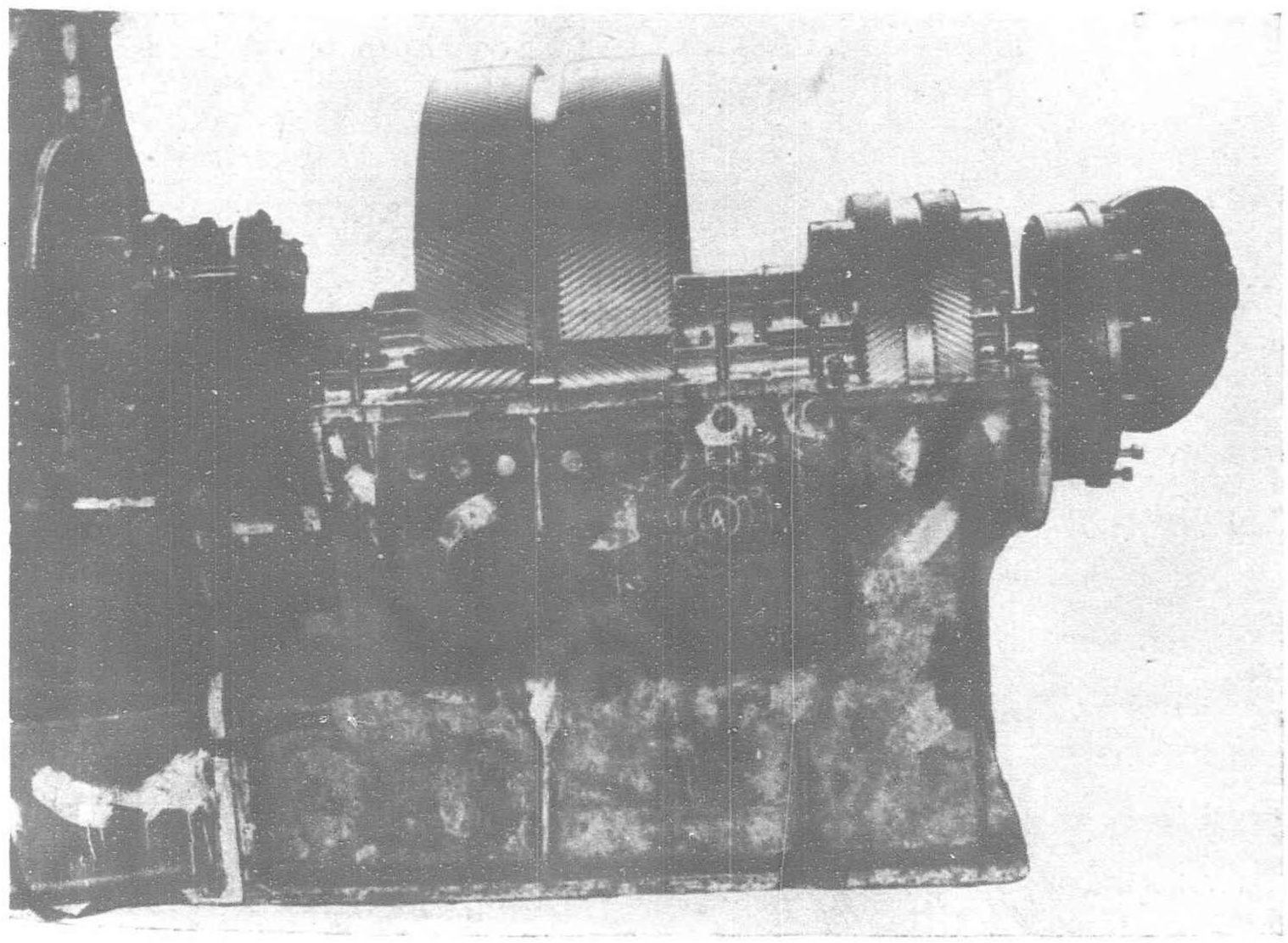


Fig. 2.—Uraga Exhaust Turbine Gearing as Overhauled

performance has been entirely satisfactory to both the builders and owners.

The main condenser is of contraflow principle with a cooling surface of 1,003 sq. ft. for maintaining a vacuum of 28½-in. with sea water at 75 deg. Fah. and atmospheric pressure at 30-in., an augmentor condenser and kinetic steam ejector being provided in order to augment the vacuum of the main condenser. An air pump of Edward type and two bilge pumps are directly driven by the main engine. The circulating water pump of centrifugal type with a capacity of 300 tons per hour is independently driven by a vertical single cylinder steam engine.

The boilers are two sets of single ended multitubular marine type with a diameter of 12-ft. 6-in., a length of 10-ft. 6-in., a total heating surface 2,950 sq. ft., a grate area 77 sq. ft. and a working pressure at 210 lb. per sq. in. superheated at 50 degrees Fah., Howden's forced draught system being used.

The propeller is one set of four bladed right hand turning type specially designed by the builders in conjunction with tank experiments, and has a diameter of 14-ft., a normal equivalent pitch of 15-ft. 1-in., and a disc area of 55.8 sq. ft.

The engine and boiler room arrangement and photographs of the exhaust turbine system are shown in Plate I and Figs. 1 and 2.

The coal consumption on service is 10-15 tons per day, when the machinery develops 700-1,000 i.h.p. This gives a fuel co-efficient—i.e. displacement $^{2/3}$ × speed ^{3}/ coal in tons per day—of about 25,400 which may be considered very high in comparison with records hitherto acquired by this class of vessel, and is even higher than that attained by Bauer-Wach's system. The builders claim a saving of 20—30 per cent in comparison with ordinary reciprocating engines.

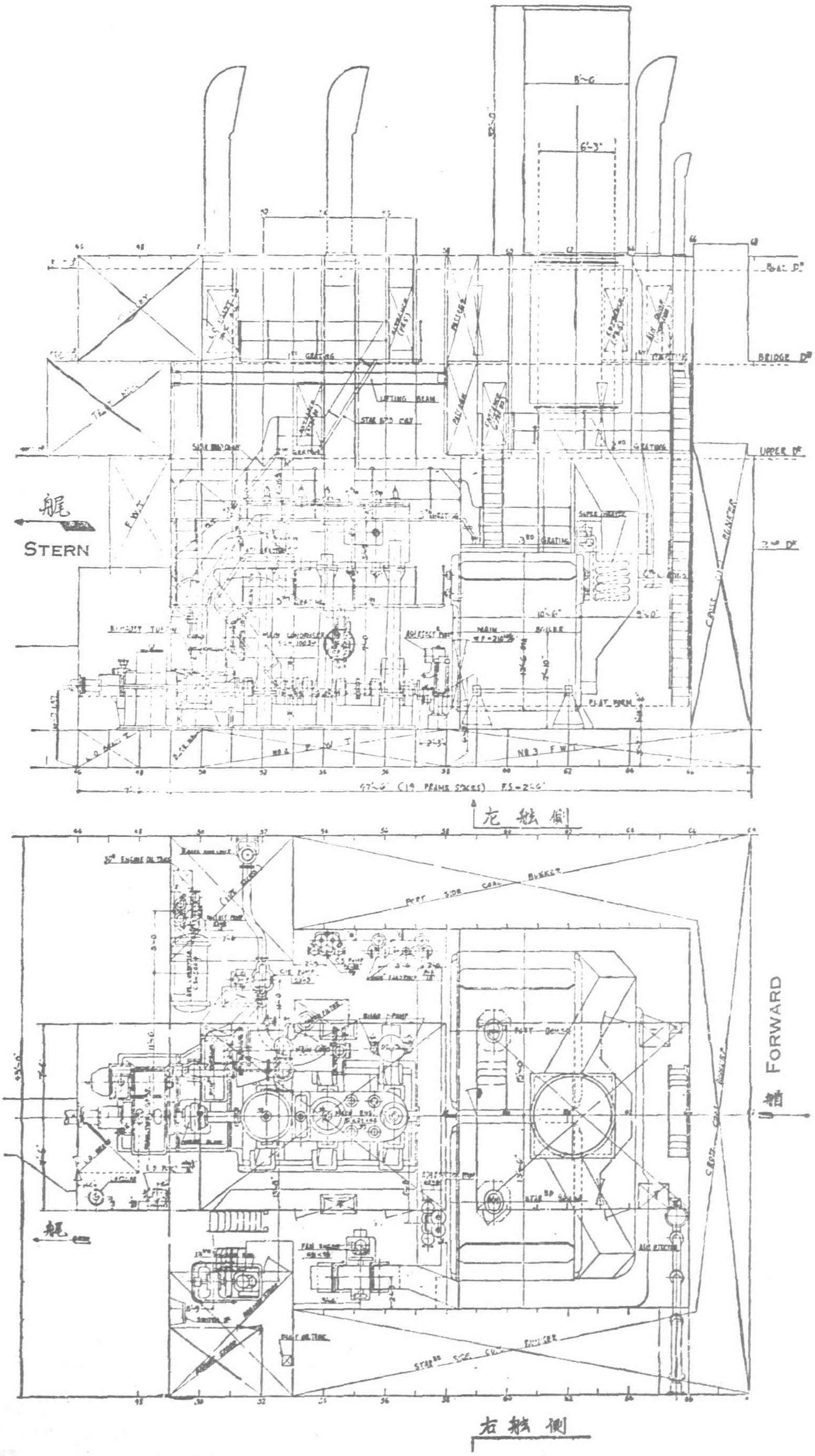
In the case of the s.s. *Johore Maru*, the writer is informed that there has been a saving of about 17 per cent of coal consumption per i.h.p. per hour at about 3,800 i.h.p with a Bauer-Wach's exhaust turbine. This turbine, however, being designed for a normal combined output of 4,000 i.h.p., a higher saving could be expected at this power.

Considering, in general, the advantages of the exhaust turbine system, it is not only confirmed from the foregoing that there is a considerable saving in the fuel consumption in comparison with the ordinary reciprocating engine installation, but also the stoking of boilers becomes easier at the same machinery power, making possible a reduction of one or two members of the boiler room, and also owing to the reduction of coal to be stowed on board for a definite route, the time and expense for coaling can be reduced, whilst the dead weight capacity of the vessel can be increased proportionately to the reduction of coal to be carried.

Further, the overheating of boilers will be minimized, and the vibration of the ship is considerably reduced owing to the better balanced torque of the complete installation.

Aboard the *Konan Maru*, three boilers were used before the reconstruction, but after the adoption of the exhaust turbine system it has been possible to operate the ship burning only two boilers, one being kept as spare. Therefore, should one boiler become damaged, the vessel could continue the scheduled voyage without dropping her speed, whilst the damaged boiler could conveniently be repaired. Thus, the reliability of service could be assured.

So far as the service experience of the ship's engineers is concerned, it is reported that the vibration of the ship and the racing of the engine in rough



Machinery Room Arrangement of s.s. "Shinkyo Maru"

新京丸機關室一般配置圖

weather have been reduced, and it has been possible to reduce the quantity of lubricating oil supply to bearings owing to the reduction of temperatures at these parts due to smoother running of the main engine.

In the Far Eastern districts or any other parts of the world where the price of oil is not sufficiently low, the exhaust turbine system with a reciprocating engine gives a considerable advantage to the shipowners and operators. It is generally considered that the pure turbine propulsion is not economical and convenient for comparatively small power, whilst in particular districts the usual advantages of Diesel engines cannot be unconditionally emphasized in view of a higher running expense and possibly a higher initial cost.

It would not be an over-estimation to reckon 35 per cent for the combined saving of coal with the exhaust turbine system and pulverized fuel installation, and these appear the most suitable remedies for inefficient steamships and for the resurrection of old uneconomical ships.

(TABLE I)

TRIAL RESULTS OF MACHINERY—S.S. *Konan Maru*

Conditions	*On Trial* Exhaust Turbine In	*On Trial* Exhaust Turbine Out	*On Service* Exhaust Turbine In	*On Service* Exhaust Turbine Out
Place	Bay of Osaka		Yellow Sea	
Atmospheric pressure and temperature	769.6 mm. 8.3°C.		758 mm.	760mm.
Weather	Cloudy		fine	fine
Sea	Slight		slight	smooth
Wind	E.	3-4	soft	Soft
Main Engine and Exhaust Turbine—				
R.P.M., main engine	62.1	61.8	56.5	56.5
R.P.M., exhaust turbine	4,293	—	4,000	—
Slip at coupling, %	4,833	—	—	—
Steam Pressure in K /cm².—				
Engine—				
Steam main, gauge	13.967	13.875	14.06	14.06
H.P. value, gauge	12.967	13.55	14.06	14.06
I.P. value, gauge	2.77	2.695	3.52	3.69
L.P. value, gauge	0.141	0.4575	0.63	0.49
Exhaust, absolute	0.4406	0.252	—	—
Turbine—				
Initial pressure, abs.	0.3463	0.161	0.38	—
Exhaust pressure, abs.	0.0455	0.161	0.038	—
Condenser—				
Top, abs.	0.0375	0.16	0.0299	0.0094
Bottom, abs.	0.03153	0.149		
Mean Eeff. Press Kg/cm²—				
H.P. Cylinder	2.796	3.834	—	—
I.P. Cylinder	0.867	1.217	—	—
L.P. Cylinder	0.2695	0.4755	—	—
Indicated H.P. (Metric)—				
Reciprocating Engine—				
H.P. Cylinder	355	484.5	364	516
I.P. Cylinder	296	413	340	507
L.P. Cylinder	258	453.5	356.5	484
Total	909	1,351	1,060.5	1,507
Exhaust turbine	490	—	446.5	—
Combined total output	1,399	1,351	1,507	1,507
Steam Temp. C°.—				
Turbine inlet	73	54.5	—	—
Turbine outlet	31.83	56	—	—
Lubricating oil press. Kg/cm²	0.8	0.8	0.7	—
Oil Cooler—				
Temperature, inlet C°.	30	24.5	35	—
Temperature, outlet C°.	20.16	19.5	25	—
CONDENSING PLANT				
Main Condenser—				
Exhaust steam press. Kg/cm.² abs.	0.0375	0.16	—	—
Exhaust steam temperature, C°.	31.83	55	32	—
Condensed water temperature C°.	26.4	31	—	—
Cooling water inlet temperature C°.	11.23	12.5	11.0	17.2
Cooling water oulet temperature C°.	20.5	24	22	30.5
Vacuum Augmentor—				
Ejector—				
Steam press. Kg/cm.² gauge	12	—	12	—
Steam consumed, Kg/hr.	106	—	—	—
Aux. Condenser—				
Exhaust steam press. Kg/cm² abs.	0.12283	0.1455	—	—
Exhaust steam temperature, C°.	49.66	—	32	—
Drain temperature, C°.	50	—	50	—
Cooling water temperature, C°.	48.33	43	49	—
Do. outlet temperature, C°.	49.5	43.5	50	—

Conditions	*On Trial* Exhaust Turbine In	*On Trial* Exhaust Turbine Out	*On Service* Exhaust Turbine In	*On Service* Exhaust Turbine Out
Circulate Pump—				
R.P.M.	285	280	—	—
Suction pressure, Kg/cm.²	—	—	—	—
Delivery pressure, Kg/cm.²	0.5966	0.5925	—	—
Engine room temperature, C°.	26	25	33	39
Coal consumption on 12 hour Trial, Kg. per I.H.P. per hour	—	—	0.785	0.975
Reduction due to exhaust turbine in %	—	—	19.37	—

(TABLE II)

A SUMMARY OF COAL CONSUMPTION TRIALS—S.S. *Konan Maru*

No of Voyage	*First Voyage*		*Second Voyage*	
Mean draught	12-ft. 0-in.	12-ft. 0-in.	24-ft 8-in.	24-ft. 8-in.
Exhaust Turbine, in or out	in	out	in	out
Indicated horse-power	1,168	1,168	1,507	1,507
Propeller revolutions per min.	57.5	57.5	56.5	56.5
Duration for measurement, hours	8	8	12	12
Kind of coal	Japanese	Japanese	Manchuria	Manchuria
Coal consumption per 24 hours, 1,000 Kg.	22.0	27.3	28.4	35.22
Reduction ratio of coal consumption %	19.4		19.37	

Aviation in Japan

Travellers to and from Chosen and Manchuria and points beyond will be carried across the Chosen Strait by giant airplanes when the Communications Office's extensive airway network plan materializes. When this plan is carried out, the trans-Strait journey will be reduced from nine hours to one.

The Communications Office, realizing the remarkable enthusiasm for aviation shown by the public, wishes to control effectively all air transportation facilities, so that they may not only serve the ends of national defence in time of need, but in order that they may work in unison with steam and electric roads and motor-car routes.

To that end the Communications Office expects to take the matter up at a Cabinet conference and subject to the approval of the Cabinet Ministers, the Office intends to organize a special Air Commission, members of which will probably be selected from among the experts of the Communications, Railway, War, Navy, and Home Offices. Influential private individuals will also be included.

The salient points of the Communications Office plan are:

(1) To complete air links between principal cities of the Empire by light planes through Government encouragement of the manufacture and operation of such craft among private concerns.

(2) To establish additional airdromes and flying fields, air beacons, and aerial radio stations.

(3) To facilitate transmission of short wave radio beams by numerous broadcasting stations in the country.

(4) To realize with the least possible delay air transportation between the main island and, Taiwan, and between Shimonoseki and Fusan. In such service, planes large enough to accommodate 50 to 60 passengers will be used.

The Communications Office intends to enlist the aid of the War and Navy Offices and private air transport concerns.

While the Communications Office is striving to complete the airway network of the country, five Municipal or Prefectural airdromes were recently completed. They are:

(1) Kanoya airdrome, Osumi Province, built and operated jointly by Kagoshima Prefecture and the town of Kanoya.

(2) Ueda, Nagano Prefecture, built and operated by Nagano Prefecture and Ueda Municipality.

(3) Toyama, built and operated jointly by Toyama Prefecture and Toyama Municipality.

(4) Ojiya, Kitauonuma-gun, Niigata Prefecture, built and operated by Niigata Prefecture.

(5) Niigata, built and operated jointly by Niigata Prefecture and Niigata Municipality.

The Municipal airdromes now under construction at Nagoya, Hiroshima, and Kanazawa, are scheduled to be completed before long, while the city of Matsue recently completed an airport for seaplanes on the southern shore of Lake Shinji.

Engineering Notes

SHIPPING

SINGAPORE BASE.—Of the total estimated cost of the Singapore Base scheme, £8,750,000, something over £5,000,000 has now been spent or voted. The main contract was placed with Sir John Jackson, Ltd., in September, 1928, and should be completed by September, 1935, but about two years more will be required for the equipment of the base and the completion of the machinery installation, making the final date for completion about the end of 1937.

HUI RIVER CONSERVANCY.—At a meeting of the Board of Trustees of the British Boxer Indemnity Fund consideration was given to a loan of $22,000,000 to the Hui River Conservancy Board; and to the proposed building of the Board's headquarters at Nanking, which will cost $45,000. The loan for the Hui River Conservancy was accepted on principle, and the report by the Construction Committee on the purchase of the site in the capital was also accepted.

LINERS SOLD TO JAPAN.—The Japanese continue to purchase British ships. It is understood that they have acquired four more British ships. Two are for demolition, the P. and O. liner *Padua*, of 3,741 net tons, built in 1912, by the J. C. Tecklenborg A.G., the Glen liner *Glenshane*, of 4,072 net tons, built in 1919 by Messrs. Harland and Wolff, Ltd., and two for trading purposes, viz., the *Canadian Inventor*, of 3,384 net tons, owned by the Canadian National Steamships, and built in 1920 by Messrs. J. Coughlan and Sons, Ltd., Vancouver, and the *Canadian Mariner*, of 3,311 net tons, also owned by the Canadian National Steamships, and built in 1920 by the Halifax Shipyards, Ltd.

INDUSTRIAL

MAGNESIUM FACTORY.—The Sumitomo interests of Osaka are contemplating embarking upon a large scale magnesium enterprise and intend to form a company with Y.50,000,000 capital. They claim to have discovered a 500,000,000 ton magnesite deposit in South Kankyo Province.

PAPER MILL EXTENSION.—The Yalu Paper Mill at Antung is to increase its daily capacity from 500 tons of pulp to 1,000 tons upon the installation of a new machinery to be bought at a cost of $200,000. The paper manufacturing capacity of the mill is to be increased to 1,000,000 lb. annually.

NEW RAYON FACTORY.—The Naigaimen Spinning Company, which owns the majority of Japanese spinning equipments in China, has decided to launch a rayon industry to make good the loss resulting from the anti-Japanese boycott. The concern has selected a site for a factory at Nishio in Aichi Prefecture, Japan.

ELECTRICAL

DEVELOPMENTS IN JAPAN.—The Japanese Government railway authorities have practically completed their investigations regarding the erection of a 25,500 kw. power station costing Y.22,000,000 on the Tenryn River in connection with the Government's second railway electrification scheme. Both the Kanagawa and Yokohama Councils have hydro-electric schemes under consideration, and good progress is being made with a thermal power station in Shinkyo, Manchoukuo.

The erection of new power stations is under consideration by the following:—The Oi-gawa Power Co. (63,000 kw. at a cost of Y.12,000,000), the Toho Power Co. (40,000 kw., Y.4,620,000) and the Imperial Rayon Manufacturing Co. (20,000 kw.). The Japan Electric Power Co. also proposes to extend the capacity of its Tokyo power station by 10,000 kw.

MACAO ELECTRIC COMPANY.—The Macao Electric Lighting Co. has placed a substantial order for new material and machinery with the General Electric Co. of China, Ltd. For the accommodation of the new generating units, a new power station is already in course of construction. This has been placed with Messrs. Dorman, Long and Co., of London, by whom all the structural materials have also been supplied. Among the equipment is a large quantity of British high tension cables, to replace all the overhead high tension lines which have been serving Macao since the company commenced operations some 20 years ago.

COMMUNICATIONS

SINKIANG RADIO STATIONS.—The Eurasia Aviation Corporation is planning the establishment of radio stations at Tihua and Hami, Sinkiang, in order to assist them with the air mail line through that province.

INDIA AND CEYLON.—Correspondence has been proceeding between the Governments of India and the Ceylon Government on the question of a telephone link between India and Ceylon. If this leads to a satisfactory arrangement, it is possible that Colombo will be linked with India by telephone before the end of next year.